Investigation into the appropriateness of the South African microinsurance solvency capital regulation

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ABSTRACT

In South Africa, there are two different regulatory capital requirement options for insurers selling microinsurance products. The first is the capital requirement for traditional insurers under the SAM framework. The second is a simplified requirement that would be applicable to registered microinsurers. This thesis provides a systematic comparison of these two requirements.

The nominal value of each requirement is compared using a model microinsurer that has been calibrated using industry data. It was found that the simplified microinsurance requirement resulted in less capital required than the SAM requirement for traditional insurers. The comparison was extended by comparing the change in requirements if the risk profile of the microinsurer changed. It was found, as would be expected, that the simplified microinsurance requirement was not as sensitive to changes in the risk profile.

The level of protection under each requirement was also assessed. This was done using various deterministic and stochastic tests. The deterministic tests involved stressing variables individually and collectively. The stochastic tests involved calculating the probability of insolvency for the model microinsurer over a one-year period. This showed that both capital requirements resulted, for the model microinsurer, in an insolvency probability of less than 0.5%, as required by SAM. However, it also showed that the lack of risk sensitivity of the simplified microinsurance capital requirement could result in significantly higher insolvency rates if the risk profile of the microinsurer changed.

The results of the tests performed also showed that it may, under certain circumstances, be acceptable to reduce the absolute minimum capital requirement under the specialised microinsurance licence. This should assist with lowering barriers to entry for small microinsurers. However, the reduction may not be sufficient to encourage informal funeral insurance providers to register with the regulator which was one of the goals of the microinsurance licence. Thus, it is concluded that the simplified requirement could be adjusted to be more risk sensitive. This could result in a lower absolute minimum and encourage formalisation.

Key words:

Microinsurance regulation, Funeral insurance, Capital requirements, SAM.

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OPSOMMING

Versekeraars In Suid Afrika wat mikroversekerings produkte verkoop het twee verskillende opsies vir die hoeveelheid kapitaal wat gehou moet word vir regulasie doeleindes – ook bekend as ‘kapitaal vereistes’. Die eerste is die kapitaal vereiste vir tradisionele versekeraars onder die SAM raamwerk. Die tweede is 'n vereenvoudigde vereiste wat op geregistreerde mikroversekeraars van toepassing is. Hierdie proefskrif bied 'n sistematiese vergelyking van hierdie twee vereistes.

Die nominale waarde onder elke vereiste is vergelyk deur geburik te maak van 'n model mikroversekeraar wat gekalibreer is met behulp van bedryfsdata. Daar is bevind dat die vereenvoudigde mikroversekeringsvereiste tot minder kapitaal as die SAM vereiste vir tradisionele versekeraars gelei het. Die vergelyking is uitgebrei deur die verandering in vereistes te vergelyk indien die risiko profiel van die mikroversekeraar verander. Daar is gevind dat die vereenvoudigde mikroversekerings vereiste nie so sensitief is vir veranderinge in die risiko profile is nie.

Die vlak van beskerming onder elke vereiste is ook geassesseer. Dit is gedoen met behulp van verskeie deterministiese en stogastiese toetse. Die deterministiese toetse het die veranderlikes individueel en gesamentlik gestres. Die stogastiese toetse het onder andere die berekening van die waarskynlikheid van insolvensie vir die model mikroversekeraar oor 'n tydperk van een jaar ingesluit. Dit het getoon dat beide kapitaal vereistes – vir die model mikroversekeraar – tot 'n insolvensie waarskynlikheid van minder as 0,5% gelei het, soos vereis deur SAM. Dit het egter ook getoon dat die gebrek aan risiko sensitiwiteit van die vereenvoudigde vereiste tot aansienlik hoër insolvensietariewe kan lei indien die risiko profiel van die mikroversekeraar verander het.

Die resultate van die toetse het ook getoon dat dit onder sekere omstandighede aanvaarbaar kan wees om die absolute minimum kapitaal vereiste onder die gespesialiseerde mikroversekerings lisensie te verminder. Dit behoort te help met die verlaging van toegangsgrense vir klein mikroversekeraars. Die verlaging mag egter nie voldoende wees om informele begrafnis versekerings verskaffers aan te moedig om by die reguleerder te registreer nie, wat een van die mikpunte van die mikroversekerings lisensie was. Gevolglik moet die vereenvoudigde vereiste aangepas word om meer risikosensitief te wees. Dit kan tot 'n laer absolute minimum lei en formalisering aanmoedig.

Sleutelwoorde:

Mikroversekeraar regulasie, Begrafnis Versekerings, Kapitaal Vereiste, SAM

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LIST OF ABBREVIATIONS AND/OR ACRONYMS

AMPS	All Media and Product Survey
APRA	Australian Prudential Regulatory Authority
BOF	Balance of own funds
CCIR	Canadian Council of Insurance Regulators
CQS	Credit Quality Step
CRO	Chief Risk Officers
EIOPA	European Insurance and Occupational Pension Authority
EU	European Union
FINMA	Swiss Financial Market Supervisory Authority
FSB	Financial Services Board
FSI	Financial Soundness Standards for Insurers
FSM	Financial Soundness for Microinsurers
GBP	British Pound
GHS	General Household Survey
IAIS	International Association of Insurance Supervisors
IBNR	Incurred But Not Reported Reserve
ICP	Insurance Core Principles
LAGIC	Life and General Insurance Capital Standards
MCR	Minimum Capital Requirement
MICR	Microinsurance Capital Requirement
MCCSR	Minimum Continuing Capital and Surplus Requirements
NAIC	National Association of Insurance Commissioners
OCR	Outstanding Claim Reserve
OSFI	Office for the Superintendent of Financial Institutions
PA	Prudential Authority
PCA	Principal Component Analysis
QIS	Quantitative Impact Study

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RBC	Risk Based Capital
SAM	Solvency Assessment and Management
SARB	South African Reserve Bank
SCR	Solvency Capital Requirements
SST	Swiss Solvency Test
TailVaR	Tail Value at Risk
UPR	Unearned Premium Reserve
URP	Unexpired Risk provision
US	United States
VaR	Value at Risk

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Microinsurance is commonly defined as “the protection of low-income individuals against specific perils in exchange for regular premium payments” (Churchill, 2007). It is a valuable tool to help protect the poor from shocks which could leave them destitute. The shocks covered are similar to those covered in traditional insurance, but the distinguishing factor is the vulnerability of the insured (Cohen & Sebstad, 2005: 397).

Microinsurance has existed in some form or another for most of history (Zanjani & Koven, 2013). However, the term microinsurance first appeared in published literature in 1999 (Microinsurance Network, 2017). This first appearance in literature also coincided with a rapid expansion in the size of the market. Most of this expansion has occurred in the developing word. It is estimated that there were roughly 280 million lives covered by a microinsurance product in 2015. This is compared to just 80 million in 2007 (Wiedmaier-Pftister, Hui Lin & Grant, 2016). It is further estimated that this market has up to three to four billion possible customers which shows that there is still likely to be significant growth in the future (Lloyd’s & Microinsurance Centre, 2009; Kalra, 2010).

The rapid growth in the market has been matched by similar growth in the regulation of microinsurance. Wiedmaier-Pftister *et al.* (2016) point out that the first country to introduce microinsurance specific regulation was India in 2005. By 2016, an additional 17 countries had also introduced microinsurance specific regulation with another 23 in the process of designing their own regulation (Wiedmaier-Pftister *et al.*, 2016). Most of this regulation involved restrictions on the type of products that can be sold, the features of the products and the distribution channels that can be used to sell the products. Some, such as the Philippines, also had different capital requirements for microinsurers (Biener, Eling & Schmit, 2014).

Despite the good progress of microinsurance regulation across the world, many challenges still remain. One of the largest is the prevalence of informality* in the sector. A strategy that has been recommended to encourage formalisation is to create less cumbersome regulatory requirements for microinsurers (Wiedmaier-Pftister *et al.*, 2016).

South Africa, which introduced its own microinsurance specific regulation with the Insurance Act (2017a), has attempted to do just that. South Africa has a large informal funeral insurance industry

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[*] informality refers to the selling of microinsurance by unregulated insurers

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which has been plagued by abuse of policyholders (CENFRI, 2013). A policy document produced by the National Treasury in 2008 outlined how this simplified regulatory approach would work (Endres, Ncube, Hougaard & van As, 2014). This policy, with some updates, is what eventually became law in South Africa.

The framework includes product restrictions and various policyholder protection mechanisms as is common in other countries' microinsurance specific regulation. However, what was different from most other microinsurance regulation was the simplification of the solvency regime that would be applicable. It introduced a simplistic microinsurance capital requirement (MICR). Endres *et al.* (2014) note that the new framework simplifies the other regulatory requirements around solvency and risk management to reflect the much simpler nature of microinsurance products.

It is of course still important that the MICR still provides adequate protection to policyholders. For the sake of consistency and to avoid regulatory arbitrage, it could be argued that the MICR should provide at least as much protection as the capital requirements for traditional insurers in South Africa.

The goal of this thesis was to do exactly that: provide a comparison of the MICR to the capital requirement under Solvency Assessment and Management (SAM), the solvency regime that all other insurers in South Africa must abide by. The aim was to determine if the MICR was a good approximation of SAM and what differences there were in the levels of protection.

1.2 PROBLEM STATEMENT

A regulatory conundrum that exists in nearly all sectors of the economy is the difficulty in setting regulation that is sufficiently strict to protect consumers, but not so burdensome that it supresses the development of the industry. This issue is of great importance in the insurance industry due to the complexity of the insurance mechanisms.

The issue is amplified in the microinsurance industry which predominately serves the poor. The vulnerability aspect of the customer base would require the market to be highly regulated to protect the consumers who have neither the means nor the expertise to determine the appropriateness of a microinsurance product or the financial security of the product provider. However, the cost of complying with overly strict regulation can place an unnecessary burden on the consumers of such products. This means that there may be situations where it is appropriate to relax stricter regulation to ensure that the complexity of the solvency regime is proportionate to the complexity of the insurer's risk.

South Africa has done so with the introduction of the Insurance Act (2017a). The natural question was if this simplification produces similar results as the standard regulatory regime.

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1.3 RESEARCH DESIGN AND METHODOLODY

To do this, the MICR was compared to the SAM Solvency Capital Requirement (SCR) which all other insurers in South Africa must hold. The capital requirement was compared using a model microinsurer. The model microinsurer was assumed to be a funeral insurer since this makes up the largest portion of the South African microinsurance market (Microinsurance Network, 2015).

The model was calibrated using market data available on South African funeral insurers. Several other sources were also used to provide the various inputs required for the model such as the Thembisa demographic model and the True South Quote Engine. The model was then used to calculate the SCR and MICR for a base scenario – one which was deemed to be most representative of the funeral insurance industry.

The SCR and MICR were also compared for microinsurers with different risk profiles to the base scenario. This was done by changing some of the input assumptions such as the premium rates, mortality rates and so on. The results were then used to show how the two capital requirements responded to changes in risk. These comparisons were done over both a one-year and ten-year period. The shorter period comparison was in line with the time period over which the capital requirements are set under SAM. The longer period comparison was performed to see how the capital requirements differed in the long-term.

Various tests were also performed on the capital requirements to gauge the level of protection they provided to policyholders. The level of protection in this thesis generally referred to the probability of insolvency over a one-year period. The tests were both deterministic and stochastic in nature. They were performed on both the base scenario and for microinsurers with different risk profiles. The results were then used to compare the level of protection between the SCR and MICR.

1.4 IMPORTANCE / BENEFITS OF THE STUDY

The main benefit of this study is that it provides a framework for comparing the insolvency risk of two different capital requirements. Such a framework would provide a useful starting point for performing a similar exercise. A similar exercise could be to compare the capital requirements of two different jurisdictions for the purpose of determining regulatory equivalence. Another example would be to compare the level of protection of an existing capital requirement with a proposed replacement. This could help inform a regulator’s decision on whether or not to implement a new capital requirement.

The framework involves a systematic approach to modelling the solvency of an insurer. It involves several tests that can be performed. As far as the author is aware, this is the first systematic attempt at modelling the solvency of an insurer under different solvency regimes.

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The actual comparison of the two requirements performed in this thesis using the devised framework would likely be beneficial for the regulator and insurers and policyholders. The regulator would benefit since it would provide insight into how different the levels of protection are amongst insurers holding the SCR and MICR. This could then inform the level of supervision required to ensure a microinsurer stays solvent. In particular, the results of the research can be used to identify which types of microinsurers the MICR is not appropriate for. These microinsurers can then either be required to hold the SAM SCR or be placed under more stringent supervision.

It would be beneficial for an insurer as it highlights the areas of risk that are not adequately captured by the MICR. The microinsurer's management can thus incorporate this information in their risk management policies. The comparison of the capital requirements for different microinsurance risk profiles can also assist a microinsurer's management with deciding which capital requirement is the most appropriate for their business.

This research could also benefit low-income individuals who currently make use of informal microinsurers. As will be discussed later in this thesis, there is some doubt as to whether this regulation will actually result in a significant rate of formalisation. This was due to the capital required under the MICR still posing a large barrier to entry for most small microinsurers. However, this thesis does suggest, as future research, a way in which this barrier can be reduced. If improvements are then made to the MICR, barriers to entry may lower sufficiently to increase the rate of formalisation.

1.5 RESULTS

The results of the comparisons showed that, as would be expected, the SAM SCR is indeed more risk sensitive than the MICR. However, it also showed that, for a standard microinsurer, the results between the two were not that significantly different. The MICR thus proved to be a good approximation for the much more complex SCR.

The scenarios in which the approximation proved to be less suitable were generally where the microinsurer was experiencing greater risk. These included situations where the microinsurer was charging an inadequate premium rate, was experiencing high mortality rates or was expanding rapidly. In such circumstances the MICR failed to capture the additional risk in the form of a larger capital requirement.

The results also showed that the MICR approach was not sufficiently risk sensitive such that the current absolute minimum requirement (R4 million) could be reduced significantly. This absolute minimum appears, based on past studies (see Chapter 5), to be too large to significantly reduce the barriers to entry for small microinsurers. The thesis concludes that to reduce this absolute minimum and lower barriers to entry, the MICR would need to be more risk sensitive.

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1.6 CHAPTER OUTLINE

The rest of this thesis is laid out as follows. Chapter 2 will provide the definition of microinsurance in South Africa. It will also discuss the history and current state of microinsurance.

A discussion on insurance regulation is provided in Chapter 3 with the focus being on solvency regulation. Chapter 4 will provide a description of the SAM regulatory environment with a focus on how it is applicable to microinsurers. Details of the South African microinsurance regulation is provided in Chapter 5.

Next, a review of the various methodologies used to compare capital requirements, in general, is discussed in Chapter 6. This is followed up by Chapter 7 which provides the framework to build a model to compare the capital requirements. Chapter 8 then provides the details of how the model works and the various assumptions used.

The results of the comparison between the capital requirements is shown in Chapter 9. Chapter 10 discusses the deterministic tests performed on the capital requirements and the results thereof. The Stochastic tests and results are discussed in Chapter 11.

Chapter 12 gives a summary of the findings, provides the conclusion of the thesis and outlines ideas for future research.

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CHAPTER 2
THE MICROINSURANCE INDUSTRY

2.1 INTRODUCTION

The term microinsurance is fairly new with it officially only being coined in 1999 (Microinsurance Network, 2017). However, the concept has been around for much longer. This chapter will discuss some of these earlier versions of microinsurance. A definition of the term microinsurance, as it exists today, is also discussed. This chapter also discusses the current state of the microinsurance market. It concludes with a discussion on the South African market.

2.2 MICROINSURANCE DEFINITION

There are many different definitions of microinsurance, but the most common definition cited in papers on the subject are those by Churchill (2007). He conceptually defines it as insurance for low-income individuals, but notes that this definition is not very useful for regulators and insurers when defining the boundaries of such products and thus gave four possible definitions (Churchill, 2007: 9).

The first is to define the product based on the target market, i.e. low-income individuals. The second is a product design definition normally based on a maximum sum assured, maximum premium or both. The third way that microinsurance was defined is by the type of provider. The final definition is by the type of distribution channel used to sell the product (Churchill, 2007: 9–10). Most insurers and regulators make use of a combination of the above definitions (Churchill, 2007: 10)

The South African microinsurance regulation is based on the second definition. The National Treasury (2011: 7–8) defines microinsurance policies as risk-only products, paying out a fixed sum assured with a maximum of R50 000 per life assured and R100 000 per person for assets insured. The policies are also limited to 12 months and automatically renewable. Further details on the product restrictions in the South African market are discussed in Section 5.3.

This thesis used the South African regulatory definition of microinsurance.

2.3 A BRIEF HISTORY OF MICROISNURANCE

Microinsurance is a fairly old concept even if the term used to describe it is rather new. For most of history, where there has been insurance, there has normally also been microinsurance. Insurance itself has existed in some form or another since the dawn of civilisation with the first recorded insurance contracts used by merchants in Babylon between 4000 and 3000 BCE

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(Greene, 2014). Life assurance itself originates in ancient Rome from guilds called benevolent societies which were a type of burial society (Haueter, 2013: 7; Greene, 2014). These would most likely be considered microinsurance today.

There are also several other examples of microinsurance found in the history books. Two of these, industrial assurance and fraternal societies, are discussed here to demonstrate just how similar some of these early policies are to the ones found today.

2.3.1 Industrial assurance

Industrial assurance is a form of life assurance specifically designed for lower income individuals. They first appeared in the 19th century in Britain and the USA (O'Malley, 1998: 684; Zanjani & Koven, 2013: 3). Besides for low premiums and sums assured – mainly aimed at paying for the cost of burials – the defining feature of these policies was the method used to sell the policies. The distribution channel involved sending out collectors who would sell the policy to the insured and collect the premiums on a weekly basis (O'Malley, 1998: 684).

The small contract, regular premiums and the regular interaction with the sales agent was why these policies were so popular with the poorer segments of society. Like all products, however, there were issues. Zanjani and Koven (2013) state that the most contentious of these was with regards to the value of the policies to customers. The distribution cost relative to the premium size appeared to indicate that the cost of the benefits under the policies were higher than with other life insurance policies. After research was published on these issues in the 1930's, they quickly fell out of favour (Zanjani & Koven, 2013: 5).

2.3.2 Fraternal society

A fraternal society or order was one that was generally organised along ethnic, religious or occupational lines (Zanjani & Koven, 2013). These societies pooled risk amongst its members by providing each member insurance coverage in exchange for a premium (Nichols, 1917). The difference between this cover and traditional cover at the time was that if a member died and there were insufficient reserves to cover the benefits for that member then the remaining members would need to pay in the deficit. This however became less of an issue as the industry matured and benefit funding levels improved (Zanjani & Koven, 2013).

Zanjani and Koven (2013) noted that the societies often offered cheaper cover than traditional insurers and often for lower sums assured. The insurance mostly appealed to low income families. Cover was also not only limited to life assurance as other types of cover was also available such as disability cover.

This industry managed to prosper up until the end of the 19th century mostly because of it being exempt from regulation. However, insolvency was a common issue for these societies which led

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the authorities to eventually impose strict regulations. This, along with the introduction of other alternatives in the early to mid-20th century, resulted in the societies falling out of favour (Zanjani & Koven, 2013: 8).

2.4 MICROINSURANCE TODAY

While the term microinsurance was first published in 1999, the first modern microinsurance products were sold in 1997 by AIG in Uganda (Lloyd's & Microinsurance Centre, 2009; Insurance Information Institute, 2017). This scheme demonstrated that microinsurance was commercially viable and the market across much of the world quickly took off (Insurance Information Institute, 2017).

Microinsurance products are currently sold mostly in the developing world with an estimated 500 million policies being sold between 2004 and 2014 (Wiedmaier-Pftister *et al.*, 2016: 6). Microinsurance products can be found in more than 80 countries across South and Central America, Africa and Asia. It is estimated that $2.4 billion in premium income was written in these areas in 2014 (Wiedmaier-Pftister *et al.*, 2016).

The expansion has been truly rapid as it is estimated that there were roughly 280 million lives covered by a microinsurance product in 2015 compared to just 80 million in 2007 (Wiedmaier-Pftister *et al.*, 2016). The market is mostly dominated by life insurance products such as funeral and credit. There has, however, been a movement to a wider variety of products such as health, property and agriculture insurance (Kalra, 2010; Wiedmaier-Pftister *et al.*, 2016).

Microinsurance can often be of huge benefit to low income individuals. Most of these individuals do not have access to savings or state security nets to protect them against external shocks that can result in them or their family entering extreme poverty (Cohen & Sebstad, 2005). It has been shown that the road out of poverty in much of the developing world can be supported if low income individuals have access to cheap good quality insurance (Cohen & Sebstad, 2005; Kalra, 2010).

There are still several challenges in the microinsurance industry that are impeding its progress. One of these is the large-scale informal insurance sector. A large informal sector means that many policyholders do not have access to the same level of protection as those in the formal insurance market. There also generally few courses of action they can take when they have been wronged (Wiedmaier-Pftister *et al.*, 2016). Such situations can often result in people mistrusting insurance which slows down the rate of expansion and the benefits that such products provide.

2.5 MICROINSURANCE IN SOUTH AFRICA

The South African market is one such market that has been plagued by abuses in its large informal sector – mostly with regards to funeral insurance. It is estimated that approximately 25% of adults

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with funeral cover have their cover provided by an informal insurer (CENFRI, 2013). The abuses often involve providing funeral services that are at a much lower quality than was promised. The provider of the insurance will often exploit the vulnerability of a family after the death of their loved one to convince them to pay for services which were promised under the insurance contracts (van den Berg, van der Linden, Hougaard & de Villiers, 2016). More details of the abuses can be found in the report published by Finmark Trust entitled *Cutting corners at a most vulnerable time: The customer's perspective on abuses in the informal funeral parlour markets in South Africa.*

Of course, all is not doom and gloom in South Africa. The formal South African Insurance market is the largest in Africa accounting for 70% of the premium income written on the continent in 2010 (Khan, 2012). It also has the one of the highest insurance penetration rates in the world. Further, approximately 65% of South Africans are covered by a microinsurance policy (Microinsurance Network, 2015).

The size and long history of insurance in South Africa means that it was a good place to test the impact that microinsurance specific regulation would have on the market. Of particular interest was how the introduction of the simplified capital requirement would impact the level of informality. While it will take time to answer this question, since the new regulation has just been introduced, it was possible in the meantime to consider both the appropriateness and the feasibility of the regulation. More details of the microinsurance regulations are provided in Chapter 5 which includes a high level discussion on its feasibility.

2.6 SUMMARY

Microinsurance is an industry that is growing rapidly across much of the developed world. Like traditional insurance, it endeavours to provide financial protection against unforeseen shocks. Unlike traditional insurance, it is much more widely accessible due to the lower sums assured.

The microinsurance market has proven to be vulnerable to abuse. As such, many insurance regulators across the developing world have rolled out microinsurance regulation in an attempt to prevent this abuse (Wiedmaier-Pftister *et al.*, 2016). The next chapter will discuss both insurance regulation in general and microinsurance regulation in particular.

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CHAPTER 3
INSURANCE REGULATION

3.1 INTRODUCTION

The insurance industry, like most industries, is regulated in most parts of the world. This chapter will discuss the uses and purpose of insurance regulation. The focus of the regulation discussed in this chapter is solvency regulation, particularly risk-based capital systems.

The chapter will initially provide an outline of the purpose of regulation and how it is enforced. It will then discuss the different features of capital regulation. The chapter will finish with a description of the capital regimes in several countries. The focus is on regimes that use a risk-based approach. The chapter concludes with a description of the regulatory environment of countries that have microinsurance specific regulation.

3.2 PURPOSE OF REGULATION

The purpose of insurance regulation, according to Klein (1995: 368), has two main components with Dembeck (2008: 5) adding a third component. The first is to ensure that the insurer remains solvent. This is required so that the insurer's promise to make payments at future points in time – possibly many years into the future – has value. This is done by ensuring, to a certain degree of confidence, that an insurer will have funds available at the time of a claim. The first component was the focus of this thesis.

The second component is with regards to the market conduct of the insurance company. The purpose of this regulation is to ensure that insurers treat their customers fairly. It is generally done by placing rules and restrictions on premiums, disclosure, policy conditions, discrimination and so on (Dembeck, 2008: 5). The final component, according to Dembeck (2008: 6), is the regulation of the distribution channels, with the focus being on intermediaries who sell insurance companies' products. This is enforced through requiring such distributors to be licenced with the possibility of legal action being taken against them should they fail to comply with the regulation.

There are two main schools of thought when it comes to the objectives of regulation (Klein, 1995: 365). The first, and the more traditional one, is the 'public interest theory', which is in line with what was described as the purpose of regulation in the preceding paragraphs. The second theory, the 'economic theory', is a more cynical take on regulation. It proposes that the drive behind insurance regulation is the self-interest of the regulator (i.e. the government). Thus, the form of regulation will be based on what provides the maximum political benefits to the government.

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Regulation, regardless of its purpose or how well it is written, would be of little use without proper enforcement. This is discussed in the next section.

3.3 ENFORCEMENT OF REGULATION

Insurance regulation will only achieve its goals if it can be properly enforced. This is normally done through a supervisory body that has been established by legislation to ensure that regulation is being adhered to. These institutions are normally granted certain powers to allow them to intervene in the market when they believe regulation is not being followed (The Organisation for Economic Co-operation and Development, 2001: 35; Dembeck, 2008: 25; IAIS, 2015: 15).

3.3.1 Insurance industry supervisors

The regulatory authority in most countries is an independent institution responsible for the supervision of the local insurance sector (and possibly other financial sectors, for example the pensions industry). Most of the supervisors discussed in this thesis are members of the International Association of Insurance Supervisors (IAIS). The IAIS (2015: 2) was founded in 1994 with the goal of ensuring that insurance supervision is effective and consistent between different jurisdictions. Membership to the IAIS is voluntary and there are currently members from nearly 140 different countries.

The IAIS (2015: 5) has provided “a globally accepted framework for the supervision of the insurance sector” known as the Insurance Core Principles (ICP) . These standards prescribe the essential components of an insurance supervisory regime to ensure a financially sound sector and adequate levels of consumer protection.

3.3.2 Regulatory action

Dembeck (2008: 25–27) outlines several actions that a regulatory authority can take against an insurer that fails to adhere to regulation. This could be in the form of a fine, a compensation payment to any victims, requiring the insurer to cease operations or intervention into the insurer’s affairs. The type of actions available to the supervisor depends on the jurisdiction and often vary significantly from country to country (The Organisation for Economic Co-operation and Development, 2001: 35–37).

3.3.3 Cost of Regulation

Garonna and Di Giorgio state that (2015) that regulatory intervention and compliance has direct and indirect costs. The direct costs arise from funding the regulator’s monitoring and intervention activities and the cost of compliance by the insurer. The indirect costs are any losses arising from lower competition or innovation as a result of the regulatory restrictions.

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The regulator will thus need to strike a balance between having enough regulation to ensure adequate protection, but not so much, that the costs – which are ultimately borne by the consumer – outweigh the benefits (Garonna & Di Giorgio, 2015). The strictness of the regulation will depend on the legislation that granted the regulatory authority its mandate.

3.4 SOLVENCY REGULATION

One of the ICP's, number 17, requires the supervisor to "establish capital adequacy requirements" that the insurers must meet "so that they can absorb significant unforeseen losses" and allow for the timely intervention of the supervisor in situations where the insurer experiences severe financial distress (IAIS, 2015: 193).

Klein (1995: 368–369) states that this can be achieved by requiring the insurer to hold assets that exceed liabilities by a certain amount – a quantitative requirement – and requiring an insurance company to be run in a sound financial manner, which is a qualitative requirement. Each insurer is then required to provide financial reports to the regulator on a regular basis so that the regulator can determine whether the company meets the relevant requirements (Klein, 1995: 368–369; IAIS, 2015: 198–201).

Regulatory requirements for insurance solvency vary by jurisdiction and have varied over time but have common factors that are nearly always present. ChandraShekhar, Kumar & Warrier (2008: 1–2) define the most important factor as the required excess of the insurer's assets over its liabilities, i.e. its required solvency margin. Most regulatory regimes specify a minimum solvency margin which insurers must demonstrate that they exceed. The regulator will also normally define a point close to this margin at which it will start to intervene in the insurer's affairs.

The purpose of this minimum is to ensure that, in the event of the regulator deciding that the insurer must be shut down due to unsustainable losses, there will be sufficient assets available to pay policyholders for the fair value of their policies and to pay for the expenses involved in shutting down the insurer (Klein, 1995: 369). If such regulation is implemented properly, then theoretically an insurer will never reach the point where they are technically insolvent, i.e. liabilities exceed assets.

3.4.1 Pre risk-based regimes

Early regulation used simplistic factors and formulas to determine the minimum solvency margin that an insurer required. These were applied to the accounting results after allowing for reinsurance (ChandraShekhar *et al.*, 2008: 2). The advantage of this approach is that it was simple to implement and easy to understand. Its weaknesses are that it does not allow for the risks an insurer faces explicitly and is not very efficient at dealing with a market that has become more complex. An example of the weakness of not allowing for the risk explicitly is that if an

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insurer’s capital requirements are based partly on the value of the technical provisions it holds, then a decrease in these provisions held (based on a change in the valuation method rather than the underlying fundamentals) will decrease its capital requirements but increase the risk (ChandraShekhar *et al.*, 2008: 3–4).

3.4.2 Risk-based solvency requirements

Risk-based capital requirement first emerged in the banking sector in the 1960’s. In the 1990’s the insurance sector also started to embark on risk based solvency requirements with the US being an early adopter of such a system (Hooker, Bulmer, Cooper, Green & Hinton, 1996: 265). Subsequently, many other countries have introduced risk-based solvency requirements. Section 3.5 will discuss some of these regimes.

One of the goals of risk-based capital is to incentivise insurers to better manage and mitigate their risks (Cummins, Harrington & Niehaus, 1993: 433). This is done by basing the minimum solvency margin calculation on the insurers risk profile. This should, in theory, result in lower capital requirements for insurers that manage their risk well. This provides a financial incentive to ensure that risks are properly managed (Cummins *et al.*, 1993: 433).

A risk based approach requires the different areas of risk to be quantified. Risk is broadly defined by Holton (2004: 22) as “exposure to a proposition of which one is uncertain.” This would naturally include both an upside and a downside. From a solvency point of view, the part of risk which is of concern is generally the downside. Hooker *et al.*(1996: 270) defintion of risk, “that events will develop worse than planned”, is likley to be more apporiate in the context of risk-based capital.

An approach to quantifying the risk an insurer faces is to model the different business processes based on some probability distribution. Some processes are of course easier to model than others and thus a pragmatic approach is often required when setting capital requirements for risks from these processes (Hooker *et al.*, 1996: 270).

The risk-based capital requirements should ideally be based on all of the risk that the insurer faces. (Cummins *et al.*, 1993: 437–438). The main risks that an insurer faces are insurance or underwriting risk, market risk, credit risk, operational risk and liquidity risk (these are defined in Chapter 4 based on the South African legislative definition).

To quantify the level of risk the insurer faces, and thus the capital required to withstand losses at a specified confidence level, a risk measure is required. Mathematically, a risk measure is a function that maps random variables to real numbers (Roccioletti, 2015: 1). For capital purposes, the random variables are the source of risk and the real numbers are the corresponding capital requirements. The most commonly used risk measures in finance are Value at Risk (VaR) and TailVaR. The former is defined as the maximum loss, over a specified period of time, at a specified probability (Szegö, 2002: 1257). The latter is defined as the expected loss over a defined time

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period given that the losses have exceeded a specified quantile of the loss distribution (Kapel, Antioch & Tsui, 2013: 13). (Section 7.2.2.5 discusses these measures in more detail.)

Kapel *et al*. (2013: 19) describes the use of a risk measure in risk-based capital as follows. The risk measure is applied to the risk profile of the insurer to determine the capital requirement at the given confidence level. Theoretically, the risk measure should be applied to the total risk of the insurer. However, such an approach would require the regulator to specify and calibrate joint risk distributions that would need to be applicable to every type of insurer to ensure consistency, yet be flexible enough so as to represent each particular insurer's risk profile. The impracticality of such an approach and the lack of data for calibration means that many risk-based regulatory regimes instead require the capital for each type of risk the insurer faces to be calculated in isolation (Kapel *et al.*, 2013: 19). Simply adding the individual requirements is not appropriate as there are diversification benefits arising from the different risks depending on how they are correlated. This can be seen been by considering the 1-in-200 year loss from two risks. If these risks are independent or loosely correlated, then it is less likely that both of the risk events causing the loss would occur simultaneously than just one of the risk events occurring. Thus, the capital that needs to be held to protect against both risks is generally less than the sum of the individual requirements.

A risk aggregation method is required to allow for these diversification benefits when combining capital requirements from different risk factors. A common approach is the use of risk matrices (The use of these matrices are demonstrated in (4.2) in Section 4.5.3). Strictly speaking, correlation matrices are used to combine the standard deviations of distributions, whereas most capital requirements are based on percentiles of the distribution (for example, the VaR). The correlation matrix approach does produce the mathematically correct quantiles if the underlying distributions are elliptical and if the dependence between the two distributions are linear (SAM Steering Committee, 2014a: 7–8; Dionne & Pressey, 2016: 13–16). These conditions do not hold for many of the risks an insurer faces which often display highly skewed distributions and tend to be more closely correlated during extreme events.

An alternative to correlation matrices is the use of copulas. These are statistical functions which are used to specify the dependence between variables. Depending on the choice of copula type, it is possible to specify different levels of correlations at different points of the distributions (Kapel *et al.*, 2013: 21; Dionne & Pressey, 2016: 17). This is useful since the correlations in the tails of distributions often differ from those around the mean. It also does not suffer from the same limitations as the correlation matrix approach.

Both approaches require sufficient historical data to calibrate. The lack of sufficient data for insurance risk means that the process is often subjective (Kapel *et al.*, 2013: 20). The use of

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copulas also requires more data than correlation matrices to correctly calibrate the tail dependencies (SAM Steering Committee, 2014a: 13).

3.4.3 Capital floor

Another important aspect of a solvency regime is the specification of an absolute minimum capital amount an insurer requires to operate. A minimum requirement was present in the pre risk-based regimes as well as the newer risk-based regimes. In fact, the United States (US) regulatory capital requirement before the introduction of the Risk Based Capital[*] (RBC) regime was only an absolute minimum.

The reason for an absolute minimum requirement is that insurance is based on the concept of pooling risk. The smaller this pool becomes, the smaller is the reduction of risk per life assured – and at a certain size, the pooling mechanism is no longer effective (IAIS, 2012: 13,24). Thus, an absolute minimum capital requirement ensures that the insurer has a sufficient risk pool such that its operations are sustainable. Another way of explaining the rationale behind the minimum is to consider the fact that the capital requirements are calibrated on the assumption that the insurer has a sustainable risk pool as the diversification benefits allowed for in the calculations arise partly due to the risk pool. If this does not hold, then the risk is higher than the capital requirement would allow for. The minimum should thus be calibrated to the point such that no insurer can operate for extended period of times with a risk pool smaller than that which is required for an insurer to be sustainable.

However, the minimum requirement also acts to keep out new entrants to the benefit of incumbent firms. This can often be the case in an insurance industry dominated by large firms which have a close relationship with the regulator (Foulis, 2018). Another point in favour of this argument is the lack of transparency with regards to how absolute minimum requirements are determined. Further, this minimum amount varies significantly between different countries (see Table 3.1). It seems unlikely that the sustainable risk pool size differed as significantly between jurisdictions as implied by the differing minimums.

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[*] Risk Based Capital refers to the name of the US regulatory system. In this thesis, risk-based capital was used to refer to any capital requirements that are determined based on the risk of the insurer. To avoid confusion, when the thesis mentions risk-based capital it is referring to the latter whereas RBC will be used to refer to the former.

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Table 3.1: Minimum capital levels[*] for selected jurisdictions ($'000s[†])

Jurisdiction	Life insurance	General insurance
Australia	7 634	3 817
Cambodia	7 054	7 054
Chile	3 675	3 675
China	30 385	30 385
EU (Solvency II)	4 385	2 965
Hong Kong	1 250	1 250
India	15 500	15 500
Indonesia	7 500	7 500
Israel	13 000	9 000
Japan	8 990	8 990
Macau	3 750	1 875
Malaysia	24 335	24 335
Mexico	1 970	1 475
Mongolia	2 455	2 045
Myanmar	4 395	29 305
New Zealand	3 445	2 065
Papua New Guinea	1 245	625
Peru	4 815	4 815
Philippines	10 885	10 885
Singapore	7 430	7 430
South Africa (SAM)	1 010	1 010
Sri Lanka	3 255	3 255
Switzerland	5 100	3 060
Taiwan	66 740	66 740
Thailand	15 310	9 185
Turkey	1 275	1 275
UAE	27 230	27 230
Vietnam	26 400	13 200

Source: Norton Rose Fulbright, 2017; The In-House Lawyers, 2017

3.4.4 Limitations of risk-based systems

While the current risk-based approaches are an improvement on the old simplistic approaches to capital requirements, the risk-based system does have limitations. Cummins *et al.* (1993: 435)

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[*] Some regulation specified separate capital requirements for composite insurers, reinsurers and microinsurers. The numbers in this table are only for life and general insurers.

[†] Figures were converted into US dollars based on exchange rates quoted on 23 November 2017.

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argues that it is almost impossible to use a set of standard formulas to determine the adequate capital that every type of insurer should hold to reflect the level of risk in their business. This is due to the difficulty in quantifying many of the factors that lead to risk and because the type of business written varies significantly across the industry.

These difficulties increase the risk that the specified requirements do more harm than good. A poorly designed system can result in several problems. Cummins *et al.* (1993: 435) discusses three such issues. Firstly, it could increase the cost of insurance if the risk is overestimated. Secondly it could distort the incentives of the insurer when making decisions with regards to the risk it is willing to take on. This could possibly lead to lower diversification benefits and thus inadvertently decrease the level of policyholder protection. A third issue is that the capital requirement results in the regulator incorrectly identifying which insurers require intervention and which do not.

3.5 THE DIFFERENT SOLVENCY REGULATORY REGIMES ACROSS THE GLOBE

The next section looks at the various insurance markets that have introduced risk-based capital requirements. This section will mostly focus on the larger insurance markets which have done so. The aim is not to give a detailed description of the particular regime but rather a high-level overview thereof.

3.5.1 Risk based systems

3.5.1.1 European Union

The European Union (EU) solvency regime is referred to as Solvency II. It came into force on 1 January 2016. The regulator that enforces the standards is the European Insurance and Occupational Pension Authority (EIOPA). Solvency II currently applies to all life and general insurers operating within the EU (EIOPA, 2016).

The Solvency II framework was designed to replace the previous framework referred to as Solvency I. The new framework's goal is to ensure consistent regulatory treatment of insurers in all member states. It also had the goal of ensuring that the calculation of the capital requirement for insurers reflected the risk profile of the particular insurer (Holzmüller, 2009: 59; Sharara, Hardy & Saunders, 2010: 6).

The Solvency II model is based on three pillars. These pillars cover quantitative, qualitative and disclosure requirements. The capital requirement that the insurer must hold under this regime before regulatory intervention is also referred to as the SCR as under SAM. There are two approaches to calculating this requirement. The first is to use a set of standard formulas. These consist of various different risk modules and correlation matrices. The second approach is to use an internal model. This would require regulatory approval of the model (Holzmüller, 2009).

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More details of exactly how the calculations are done are shown in Chapter 4. That chapter covers the SAM calculations, but these are very similar to Solvency II.

3.5.1.2 Switzerland

A similar regulatory regime, but one which was introduced earlier than Solvency II, is the Swiss Solvency Test (SST). It was introduced in 2008 and is supervised by the Swiss Financial Market Supervisory Authority (FINMA). It consists of both a quantitative and qualitative part. There is also scope in the calculations of the capital requirement for an internal model if this is approved by the regulator (Holzmüller, 2009; FINMA, 2018).

An important difference between the two regimes was that the SST capital requirement is determined based on the TailVaR risk measure whereas Solvency II is based on the VaR (Forsberg, 2010; Kinrade & Coatesworth, 2013).

3.5.1.3 United States

The US was one of the early adopters of a risk-based approach with its risk-based standards being adopted in 1994. As mentioned previously, the capital requirement in the US is referred to as RBC. It is supervised by the National Association of Insurance Commissioners (NAIC) which is made up of all the different States regulators. The capital requirement is based on three separate formulas for life, general and health insurance. Under each requirement, there are formulas to determine a charge for each risk type included in the regulation. These are then aggregated with an adjustment made for covariance (Holzmüller, 2009; Sharara *et al.*, 2010).

The minimum capital that an insurer must hold is referred to as the Authorised Control Level. NAIC specifies five different levels of intervention in an insurer's affairs. The first intervention occurs once the free capital of the insurer falls below twice the Authorised Control Level (Sharara *et al.*, 2010; Zheng, 2016).

Sharara *et al.* (2010) argues that a weakness of the RBC is that some of the assumptions, such as the valuation interest rate and mortality rates, are specified by NAIC. This means that some of the RBC calculation is not company specific. Whilst the RBC does revise these assumptions and the calculation formulas periodically, it does increase the risk of the calculations being out of date.

3.5.1.4 Canada

The capital requirement in Canada is referred to as the Minimum Continuing Capital and Surplus Requirements (MCCSR). It is supervised by the Office for the Superintendent of Financial Institutions (OSFI). It was first introduced in 1992 and is updated each year if the OSFI deems this necessary. The capital requirement is based on five different risk categories. These are calculated using factor-based charges. A similar approach to the RBC is used to aggregate the different risk charges, although an insurer will need to provide additional information in many

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cases to prove the diversification benefit. The OSFI also allows the insurer to make use of an internal model, if approved by them (Sharara *et al.*, 2010; OSFI, 2015; Zheng, 2016).

3.5.1.5 Australia

The solvency regime in Australia is referred to as the Life and General Insurance Capital Standards (LAGIC) and is also based on the three pillars approach as Solvency II. The standard is supervised by the Australian Prudential Regulatory Authority (APRA). The capital standard is similar to Solvency II, although some of the methodologies and calculations do differ (Duncanson & Stumbles, 2011). The standard came into force in 2013.

3.5.1.6 Conclusion

It was interesting to note how similar the frameworks of many of the solvency regimes were. Whilst there were significant differences in many of the calculations methodologies and the risks allowed for, the underlying frameworks were all fairly similar. This does seem to indicate that there is indeed a harmonisation of international standards as the different regulators learn from one another. This was at least the case for the insurance markets reviewed in this section.

3.5.2 Microinsurance specific

Also, of interest were regulatory regimes that had separate microinsurance regulation. As of November 2016, there were 18 countries with microinsurance specific regulation. There were also an additional 23 countries that were in the process of designing such regulation. Most of these countries are in the developing world where microinsurance is more prevalent (Wiedmaier-Pftister *et al.*, 2016).

Table 3.2 provides a list of selected jurisdictions with microinsurance specific regulation. The chosen jurisdictions have generally had microinsurance regulation in place for some time. Most of the microinsurance specific regulation is aimed at restricting what can and cannot be offered to low income individuals. In general, there were very few regulatory regimes that reduced the capital requirement for a microinsurer.

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Table 3.2: A list of selected jurisdictions with microinsurance specific regulation

Country	**Microinsurance specific regulation**
Brazil	Brazil's regulator defines microinsurance as products aimed at the low-income market rather than basing the definition on the sum assured / premium charged. Brazil introduced separate microinsurance regulation in 2013. The licence provided a relaxation of some of the regulation applied to normal insurers. It also provided tax advantages. There are still some concerns about barriers to expansion of microinsurance in Brazil. The main one is that there is still a large capital requirement for microinsurers. It is also not possible to sell health insurance under this license.
Mexico	Microinsurance is defined in Mexico as insurance products aimed at low income individuals using low-cost distribution and operation methods. The microinsurance specific regulation was introduced in 2008. The regulation places limits on the sums assured. Other policy restrictions place limits on deductibles, co-payments and exclusions. There is no difference between the capital requirement under a normal insurer and a microinsurer under this legislation.
Peru	There are a wide range of conditions that apply to a product defined as microinsurance in the Peruvian market. In essence it is insurance products aimed at people with a low income to protect against human and economic risks. The regulation was first introduced in 2007. There is no difference between the capital requirement under a normal insurer and a microinsurer under this legislation.
Philippines	In the Philippines, microinsurance is defined as insurance products meeting the needs of the disadvantaged. There are restrictions on both the premiums and benefits – although the restrictions to the benefits only applies to life insurance. This regulation was introduced in 2007 and reformed in 2010. The regulation allows for a significant decrease in the capital required compared to a conventional insurer.
India	Microinsurance in India is defined as a life or general insurance policy with a sum insured of less than Rs50 000. There are also restrictions on the age of the policyholder and the contract duration. The regulation was first introduced in 2005. There is no difference between the capital requirement under a normal insurer and a microinsurer under this legislation.

Source: Alip, Navarro & Caribog, 2009; Iravantchi & Wenner, 2012; Biener *et al.*, 2014

3.6 SUMMARY

This chapter discussed how solvency regulation has developed from very simplistic approaches to the more complicated risk-based approaches common across much of the developed world. It

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also provided examples of regulatory regimes that are currently in force. These included complicated risk-based regimes and regimes which have separate regulation for microinsurance.

This detail provided the background information on solvency regimes which is useful to consider when reviewing the South African Regulatory landscape.

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CHAPTER 4
SOLVENCY ASSESMENT AND MANAGEMENT

4.1 INTRODUCTION

This chapter will discuss the objectives of SAM, the implementation process, how it was derived and an overview of the technical details relevant to this thesis. The purpose of this chapter is not to give an exhaustive description of all the technicalities, rules and restrictions of SAM, but rather an overview of the key concepts and calculations relevant to this thesis. Full details of SAM are provided in the Financial Soundness Standards for Insurers (FSI) produced by the Prudential Authority (PA).

4.2 OBJECTIVES OF SAM

SAM is the risk-based solvency regime for the South African insurance market that applies to both long- and short-term insurance providers. The formation of this new regime was done for several reasons, the prime one being to ensure that the South African Insurance Industry complies with international standards. Additionally, the goal was to qualify for third country equivalence with Solvency II regulation (FSB, 2010: 4).

The quantitative aspect of the regime aims to ensure that the capital requirement corresponds to the risk that the insurer faces. The requirements are thus risk based and proportionate to the size of the insurer and the complexity of its business. The qualitative aspects of the regime aim to encourage better risk management and mitigation. The combination of these two aspects should ideally lead to improved financial stability (FSB, 2010: 4; Khoza, 2015).

4.3 IMPLEMENTATION OF SAM

SAM was first proposed in November of 2010 in a detailed 'roadmap' produced by the FSB (2010). This roadmap envisaged the implementation of the regime by January 2014, however, in 2014 the FSB revised its implementation date to January 2016 (Brinckmann & Forster, 2014; FSB, 2014a: 6). The date for implementation was then further delayed to July 2018 (FSB, 2017a: 4) as SAM became part of the implementation of a twin peak approach to financial regulation (Khoza, 2015). SAM was finally implemented in July 2018 under the new Insurance Act (2017a).

The twin peak legislation has also since been implemented under the Financial Sector Regulation Act (2017b). It created two new regulators. The first is the PA, which would be housed at the South African Reserve Bank (SARB) and be responsible for financial oversight and stability. The second would be the Financial Sector Conduct Authority (FSCA), which will come from a restructured FSB and be responsible for market conduct. This changed the previous set up where

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the SARB was the regulator for the banking sector and the FSB for most of the rest of the financial sector (EY, 2016; FSB, 2016).

4.4 THIRD COUNTRY EQUIVALENCE

Achieving third county equivalence with the EU's Solvency II was an important aspect when SAM was designed and remains one of the major goals. The point of this objective is to maintain and expand the important economic relationship between South Africa and the EU (FSB, 2010: 9).

There are three forms of equivalence recognised under the Solvency II framework, with South Africa interested in the group supervision article. This article allows EU member states to rely on the supervision by a third country regulator of an insurer operating in the member state, but whose parent company is based in the third country (Membery & Dannheisser, 2016). According to the FSB (2015: 19), South Africa had applied for third country equivalence and was still awaiting a decision by the European Commission. Equivalence had not been achieved at the time of writing this thesis.

The goal of equivalence has resulted in SAM being conceptually similar to Solvency II. SAM was designed by adjusting the Solvency II framework so that it was appropriate for the South African context (FSB, 2010: 4).

4.5 OUTLINE OF SAM

SAM is based on three pillars, as Solvency II is. The first pillar is quantitative in nature. It sets out how an insurer should set up a balance sheet that will be used to determine if they hold sufficient capital to be deemed financially sound. The second pillar is qualitative in nature. It deals with the rules that the insurer should follow and processes that should be implemented to ensure sound governance and good risk management. The final pillar deals with reporting and disclosure such that the regulator and the public can be assured that the insurer has complied with the first two pillars (Deliotte, 2017: 2).

SAM has separate rules and guidance for insurance group, individual insurers, foreign reinsurers, Lloyds of London and microinsurers. The focus of this chapter was on the parts of the standards for individual insurers that would be applicable to a microinsurer if it chose to follow the individual insurer standards as opposed to the microinsurer standards.

4.5.1 SAM balance sheet

SAM requires that the balance sheet is set up in a market consistent manner and allows for the interdependency between the various assets and liabilities (FSB, 2010: 16). This requires assets to "be valued at the amount for which they could be exchanged between knowledgeable willing parties in an arm's length transaction" and liabilities "at the amount for which they could be

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transferred, or settled, between knowledgeable willing parties in an arm's length transaction" (Deliotte, 2017: 6).

The assets can be divided into three components. The first are the assets used to back the technical provisions. The second, the Basic Own Funds (BOF), is the amount by which the assets exceeds the liabilities with the addition of any subordinated liabilities (those that are paid back after policyholder's reasonable expectations are met in the event of a wind-up). The third component is Ancillary Own Funds which are loss absorbing assets that are not on the balance sheet such as any financial guarantees (Deliotte, 2017: 4; PA, 2018a: 6).

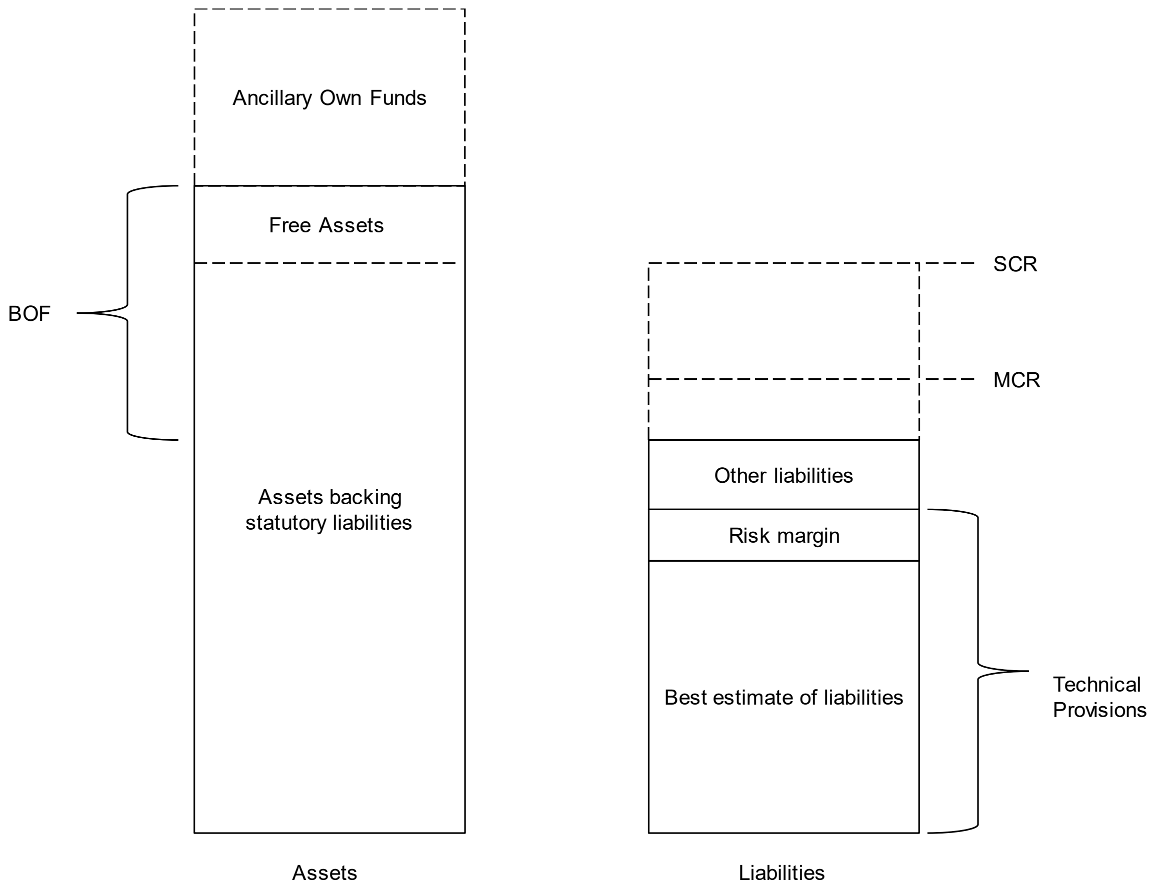

Figure 4.1: SAM balance sheet

Source: Deloitte, 2017: 6

The liabilities can also be divided into three components. The first is the technical provisions which is the best estimate of the policyholder liabilities, valued by discounting the future expected cashflows at the appropriate risk-free interest rate, plus a risk margin (PA, 2018a: 4–6). The risk margin is the sum of the cost of capital (specified in the regulation as 6%) required to hold the SCR for each future year until the liabilities are fully settled, discounted at the relevant risk free interest rate (PA, 2018b: 18–20). The second component are all liabilities other than technical provisions. The third component is the SCR which is discussed in Section 4.5.2. The SCR also

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has a subset requirement, the minimum capital requirement (MCR), which is discussed in Section 4.5.7

The division between the assets and liabilities are show in Figure 4.1.

4.5.2 SCR

The SCR is the amount of capital that the insurer must hold in excess of its technical provisions and other liabilities to prevent regulatory intervention. This capital must be invested in certain types of assets (PA, 2018a: 3). The details of and restrictions on the asset types can be found in *Prudential Standard FSI 4: Calculation of the SCR Using the Standardised Formula*.

An insurer can calculate its SCR using either the standard formula under SAM or an internal model. The use of a full or partial internal model requires approval from the PA and should be calibrated to a 99.5% value at risk (PA, 2018c: 3). The approval process was beyond the scope of this thesis, but more details can be found in *Prudential Standard FSI 5: Calculation of the SCR Using a Full or Partial Internal Model*.

The standard formula SCR is based on the risk of the insurance company in the forthcoming year. It is determined by aggregating the results of stress tests performed on each factor from which risk arises for the insurer. The stress test are designed so that there is only a half percentage probability of the insurer experiencing losses exceeding the SCR in the forthcoming year (PA, 2018a: 3).

The factors, on which the stress tests are performed, are categorised into different risk modules and sub-modules. Each stress test was calibrated according to a 99.5% VaR over a one-year period. The size of the decrease in BOF under the stress is then the amount of capital that needs to be held. The capital requirements of each module are then combined using a correlation matrix (Deliotte, 2017: 16).

The structure of the SCR under SAM was derived from the Solvency II framework and then adjusted for the South African context. The different risk modules – along with the relevant changes from Solvency II to SAM – are shown in Figure 4.2. The most significant change from Solvency II is the removal of the health and default risk sub modules. The health risk module components were instead included under the various life risk sub modules. The default risk of counterparties has been allowed for in the other relevant sub modules, for example the impairment of a reinsurer who provides reinsurance for various non-life insurance policies sold by an insurer would be allowed for directly in the non-life risk module (SAM Steering Committee, 2014a).

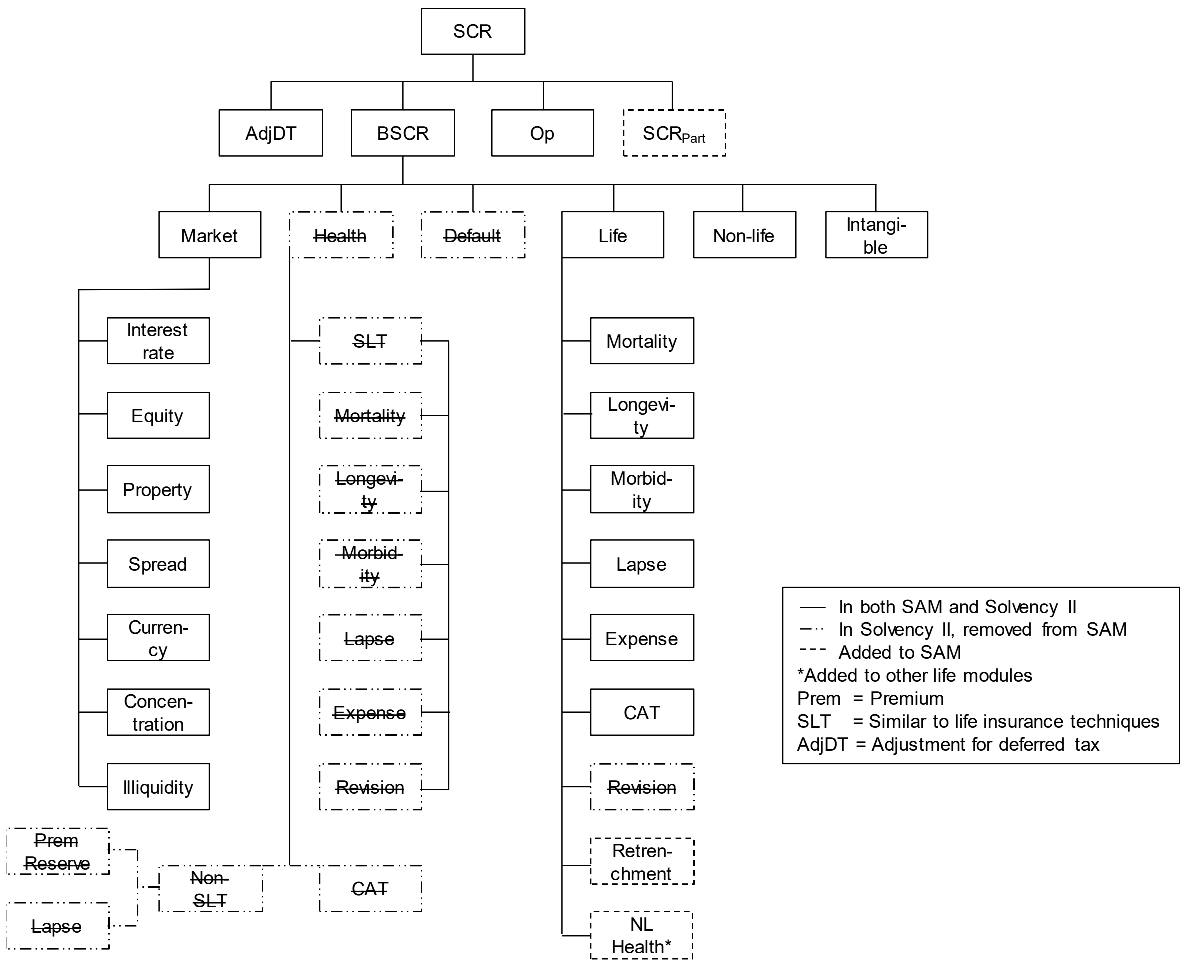

Figure 4.2: SAM SCR framework

Source: SAM Steering Committee, 2014a: 25

(4.1) shows how the SCR is calculated from the various risk modules (PA, 2018d: 11–12). The Basic solvency capital requirement (BSCR) is discussed is Section 4.5.3 and operational risk, denoted as SCR_{op}, is discussed in Section 4.5.6. The capital requirement for insurance-related participation denoted as SCR_{part} would not be applicable to a microinsurer and is thus not discussed further. The adjustment factor for deferred taxes which have the capacity to absorb losses, denoted as $AdjDT$ was not expected to have a large impact on the capital requirement for a microinsurer and was thus ignored.

$$SCR = BSCR + SCR_{op} + SCR_{part} + AdjDT \tag{4.1}$$

The final structure, stress test for each module and correlation matrices were each determined after five quantitative impact studies (QIS) in the EU for Solvency II and then three QIS's in South Africa. The purpose of the QIS's was to determine both the economic impact of the proposed

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legislation and to receive feedback about the appropriateness of the proposed framework (FSB, 2010: 11, 2014b: 18).

The remainder of this section will present the form of the SAM risk modules relevant to the funeral insurer that was modelled in this thesis. This will also involve a discussion on how they arrived at the form of the risk module. The insights into how the capital requirements were determined was useful as they gave an indication as to how the adequacy of the capital requirements can be tested and how alternative capital requirements can be determined.

4.5.3 BSCR

The BSCR calculation is designed to allow for diversification benefit between the different risks that the insurer faces. It is calculated as is shown in (4.2) where SCR_i is the capital requirement for a risk module i and $CorrBSCR_{i,j}$ is the correlation between risk module i and j. The capital requirement for risk module i is calculated according to (4.3). In this equation, $SCR_{i,k}$ is the sub risk module k, which is a sub module of risk module i and $Corr_iComponent_{k,l}$ is the correlation between sub risk module k and l (PA, 2018d: 10–11). The BSCR correlations are shown in Table 4.1.

$$SCR = \sqrt{\sum_{i,j} CorrBSCR_{i,j} \times SCR_i \times SCR_j} \tag{4.2}$$

$$SCR_i = \sqrt{\sum_{k,l} Corr_iComponent_{k,l} \times SCR_{i,k} \times SCR_{i,l}} \tag{4.3}$$

Table 4.1: BSCR correlation matrix

	Market	**Life Underwriting**	**Non-life Underwriting**
Market	1	0.25	0.25
Life Underwriting	0.25	1	0
Non-life Underwriting	0.25	0	1

Source: PA, 2018d: 11

This approach to aggregating the risk modules was determined under the Solvency II framework. The concern with this framework during the EU QIS's was that it does not properly allow for the effects of non-linearity and tail dependencies, as discussed in Section 3.4 (SAM Steering Committee, 2014a: 11). The EIOPA decided that taking these into account did not meet the

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principle of proportionality. Instead, a pragmatic approach with an appropriate level of prudence to account for these difficulties was preferred (SAM Steering Committee, 2014a: 6).

The FSB (2014a: 14) decided to use the same aggregation method as Solvency II as they deemed it highly unlikely that South Africa would be able to make use of a more sophisticated structure if the EU could not. They did, however, indicate that it is an area where improvements may be possible at a later date.

The FSB tried several correlation parameters between the different risk modules in the various QIS's but concluded that the parameters used in Solvency II were the most appropriate (SAM Steering Committee, 2014a: 28).

4.5.4 Life risk module

The capital requirement under the life risk module is calculated using (4.3). The different sub risk modules used to calculate the life risk module are mortality, longevity, disability, lapses, expenses, catastrophe and retrenchment risk. The correlation parameters to be used in the calculation is shown in Table 4.2.

The discussion of the sub risk modules will focus mostly on those relevant to a funeral insurer which were mortality, lapses, expenses and catastrophe risk. Details of the calculations of the other sub risk modules can be found *in Prudential Standard FSI 4.2: Life Underwriting Risk Capital Requirement*.

4.5.4.1 Correlation matrix

The correlation parameters used in SAM for the life risk module are similar to those used in Solvency II with a few adjustments. The correlation parameters under Solvency II were determined using expert opinion as there was no suitable data to calibrate the parameters. This was why SAM adopted a similar set of parameters as the data issue was likely to be worse in South Africa (SAM Steering Comittee, 2015: 11).

Mortality and Longevity risk are deemed to be negatively correlated, but the offsetting affect is not perfectly negatively correlated and hence the correlation parameter was -0.25 and not -1. In Solvency II it was assumed that changes in lapse or disability risk would affect expenses and thus a correlation parameter of 0.5 was chosen (SAM Steering Comittee, 2015: 6). Under SAM, however, the correlation between lapses and expenses has been set at zero due to the lapse module under SAM (see Section 4.5.4.4) being designed to capture the correlated risk. This was done by allowing for an increase in the per policy expense assumption under the mass lapse scenario by keeping expenses constant for two years under the scenario. Thus using the Solvency II correlation parameters would result in double counting (SAM Steering Comittee, 2015: 13).

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It was assumed that an extreme event envisaged in the Catastrophe risk module would have an impact on mortality, disability and longevity risk and thus a correlation parameter of 0.25 was used (SAM Steering Comittee, 2015: 6). This is the same as under Solvency II. The rest of the risk pairs were either independent or had low correlations and thus had a parameter coefficient of zero as under Solvency II (SAM Steering Comittee, 2015: 6).

Table 4.2: Life risk module correlation matrix

	Mortality	**Longevity**	**Disability**	**Lapses**	**Expenses**	**Catastro-phe**	**Retrench-ment**
Mortality	1	-0.25	0.25	0	0.25	0.25	0
Longevity	-0.25	1	0	0.25	0.25	0	0
Disability	0.25	0	1	0	0.5	0.25	0
Lapses	0	0.25	0	1	0	0.25	0.25
Expenses	0.25	0.25	0.5	0	1	0.25	0.25
Catastro-phe	0.25	0	0.25	0.25	0.25	1	0
Retrench-ment	0	0	0	0.25	0.25	0	1

Source: PA, 2018c: 4

4.5.4.2 Mortality risk

Mortality risk was defined by the PA (2018c: 4) as "the risk of loss or adverse change in the value of insurance obligations resulting from changes in the level, trend or volatility of mortality rates". This was likely to be a major risk for any funeral insurer and was thus an important risk module for this thesis.

The capital requirement is the difference between the BOF when the mortality rate for each policyholder is increased by 15% and the BOF under normal mortality rates. There are more details that can be found in the relevant guidance note (PA, 2018c: 4–5) that would apply to more complex insurance contracts but were beyond the scope of this thesis.

SAM allows for simplifications under certain conditions. One such condition is when the contract boundary* is less than one year. This is the case with funeral insurance and thus the capital requirement can be calculated using (4.4) (PA, 2018c: 16).

* The contract boundary under SAM is defined as the future point in time where the insurer has the unilateral right to terminate the contract, reject the premiums payable under the contract or amend the premium or benefits payable such that premiums fully reflect the risk (SAM Steering Committee, 2014d).

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The SAM requirement is identical to that of Solvency II. The 15% increase was initially calibrated based on a report in the UK in 2004 and then revised based on the results from the EU QIS's. These revisions were based on the industry comments from the study and expert opinion. It was decided by the SAM Steering Committee (2014b: 6) that there was no appropriate argument or statistical evidence to calibrate the sub module in some other way.

$$0.15 \times CAR \times q \times n \times 1.1^{(n-1)/2} \tag{4.4}$$

where CAR is the capital-at-risk (Total sum assured for all lives minus reserves held)

q is the weighted average mortality rate, where the weights are the sums assured

n is the modified duration of the cashflows with a minimum of one

4.5.4.3 Lapse risk

The PA (2018c: 9) defines lapse risk as "the risk of loss or adverse change in the value of insurance obligations due to changes in the expected exercise of contractual options". These include options to end the contract, renew the contract, change in the amount of cover or provide periods of premium waivers.

The capital requirement is the maximum decrease in the BOF of three stress events. The first event is a mass lapse scenario in which 40% of individual policyholders and 70% of group contracts lapse their contracts immediately. Fixed costs are to remain constant throughout the year at the amount they would have been had no lapse occurred. The second stress event is the greater of a 50% decrease in the rate of option exercise or 50% increase in the rate of option exercise (PA, 2018c: 9–11).

The final event was a combination of the first two events and is calculated using (4.5). In this equation, $Lapse_{mass,i}$ is the decrease in BOF due to a mass lapse event for the homogenous group (the first event described above) of policies i and $Lapse_{level,i}$ is the decrease in BOF for homogenous group i as described in the second event above. The $Lapseshock_{mass}$ is defined as the lapse percentage used (40% or 70%) in the mass lapse scenario (PA, 2018c: 10–11).

$$\sqrt{\left(\sum_i Lapse_{mass,i}\right)^2 + \left(\sum_i Lapse_{level,i} \times (1 - 0.5 \times Lapseshock_{mass})\right)^2} \tag{4.5}$$

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The second stress event was only relevant to insurers that sell products with surrender strain, either positive or negative. Funeral insurance products have minimal surrender strain and thus this section of the capital requirement was not relevant for this paper. The third stress event simplifies into the first event if we assume the stress under the second event is immaterial. The first stress event would thus be used to calculate the lapse capital requirement for a funeral insurer.

This mass lapse event, under Solvency II, was initially defined as a lapse of 30% of individual policies and 70% of group policies in Solvency II (This has since changed). These rates were determined using expert opinion due to a lack of data for a more sophisticated calibration technique (SAM Steering Committee, 2015a: 8). The Sam Steering Committee (2015a: 14, 22) decided that this rate was too low given the high lapse rates observed on some South African insurance products and used several higher rates in the QIS's before settling at 40% for individual and 70% for group.

Further differences between Solvency II and SAM is the addition of the requirement that fixed expenses remain the same as before the lapse events for a period of one year under SAM and that the correlation parameter between lapse and expense risk is changed from 0.5 to 0 (SAM Steering Committee, 2015a: 28). The reason for this change was due to the SAM Steering Committee (2015a: 23) believing that an explicit allowance for expenses captured the risk better than through the correlation parameter.

4.5.4.4 Expense risk

The PA (2018c: 12) defines expense risk as "the risk of variation in the expenses incurred in servicing insurance obligations, including the risk from the growth in expenses over and above inflation". This was an important risk for this paper as funeral insurers generally have high expenses relative to the premium. In 2016 an average of 48% of the premium income across the funeral insurance market was used to pay claims which indicates that most of the premium is to cover the insurer's expenses – including commission (Insurance Division, 2017a: 21).

The capital requirement is calculated by determining the decrease in BOF after a 10% increase in future expenses and an increase in expense inflation of either 2% in absolute terms or 20% in relative terms, whichever is greater (PA, 2018c: 12). A simplification is allowed for where the contract term is less than one year, as is the case with a funeral insurance product. (4.6) shows how to calculate the requirement under the simplification (PA, 2018c: 21).

$$0.1 \times n \times E + \left(\frac{1}{k} \times ((1+k)^n - 1) - \frac{1}{i} \times ((1+i)^n - 1)\right) \times E \tag{4.6}$$

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where n is the modified duration of the cashflows with a minimum of one

E is the previous 12 months' expenses

k is the stressed inflation rate

i is the weighted average inflation rate from the past 12 months where the weights are the present value of the expenses that inflation rate applies to

This stress test amount was derived from the Solvency II expense sub module. The Solvency II stress level was calibrated based on several studies done in the UK. These studies, along with expert opinion, resulted in the Solvency II stress test requirement being a 10% increase in expenses and a one percentage point increase in expense inflation (SAM Steering Committee, 2015b: 4–5).

The SAM Steering Committee (2015b: 9) believed that there was not enough data to justify using a different value for the expense increase percentage. They further noted that this was roughly equivalent to the pre-SAM legislation. It was unclear as to why they decided to change the inflation rate stress.

4.5.4.5 Catastrophe risk

Catastrophe risk is defined by the PA (2018c: 13) as "the risk of loss, or adverse change in the value of insurance obligations, resulting from extreme or irregular events whose affects are not sufficiently captured by" the other sub risk modules. The capital requirement is based on catastrophes that affect either the mortality rate or the morbidity rate. Only the former will be discussed since this is the risk that would be relevant to the funeral insurer considered in this thesis.

The capital requirement is the decrease in BOF following an increase in the mortality rate for a one-month period. The rate of increase is shown in (4.7) where $MortRate$ is the mortality rate per 1000 per month for each policyholder or homogenous group of policyholders (PA, 2018c: 13–14).

$$\frac{4 \times min(max(0.2 \times MortRate + 0.105; 0.125); 0.3)}{1000} \tag{4.7}$$

The approach taken by the SAM Steering Committee (2015c: 8) to determine the catastrophe risk module was similar to Solvency II, although the stresses used were higher due to the widespread prevalence of HIV in South Africa and the less developed healthcare system. This implied that a pandemic like event would be more devastating than would be the case in Europe.

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The shock under Solvency II was an increase in deaths of 1.5 per mille in the month of the catastrophe. SAM made use of a linear formula that started at the Solvency II rate and increased as the underlying mortality increased up until a maximum of 3.6 per mille (SAM Steering Committee, 2015c: 9). The FSB (2017b: 10–11) revised the shock from a one-month mortality increase to a three-month increase to reflect the fact that pandemics are expected to occur over a longer period of time than one month. The 3.6 per-mille was thus reduced to a maximum of 1.2 per mille per month for the three months.

There was once again a simplification for insurance contracts with terms of less than one year which is shown in (4.8) (PA, 2018c: 11). If the contract boundary was less than three months, then the new shock would be less than that of the original.

$$\sum_i MortCATshock \times CAR_i \times \min(CB_i; 3) \tag{4.8}$$

where $MortCATshock$ is (4.7)

CAR_i is the capital-at-risk for policyholder i (Sum assured minus reserves held)

CB_i is the outstanding contract boundary in months set to no less than one

4.5.5 Market risk

The capital requirement under the market risk module is calculated using (4.3). The different sub risk modules used to calculate the market risk module are interest rate, equity, property, currency, spread and default, concentration and illiquidity premium risk. The correlation parameters to be used in the calculation are shown in Table 4.3.

The capital requirement for market risk is fairly small for a funeral insurer due to the restriction of investments to money markets (PA, 2018e: 7).This meant that the only relevant sub risk modules were the spread and default risk module and concentration risk module. Details of the calculations of the other sub risk modules can be found in *Prudential Standard FSI 4.1: Market risk capital requirements*.

4.5.5.1 Correlation matrix

The correlation matrix used in Solvency II was calibrated by making use of both quantitative and qualitative data. The financial crisis of 2008 provided a great deal of empirical evidence to assist with determining the appropriate correlation parameters (SAM Steering Committee, 2014c: 6).

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The SAM steering committee (2014c: 18) used the Solvency II framework with a few adjustments. The calibration process and adjustments were beyond the scope of this thesis due to the risk module not being an important factor for a funeral insurer.

Table 4.3: Market risk module correlation matrix

	Interest	Equity	Property	Spread & default	Currency	Concen-tration	Illiquidity premium
Interest	1	A*	A*	A*	0.25	0	0
Equity	A*	1	0.75	0.75	B†	0	0
Property	A*	0.75	1	0.5	0.25	0	0
Spread & default	A*	0.75	0.5	1	0.25	0	-0.5
Currency	0	B†	0.25	0	1	0	0
Concen-tration	0	0	0	0	0	1	0
Illiquidity premium	0	0	0	-0.5	0	0	1

Source: PA, 2018b: 4

4.5.5.2 Spread and default risk

The PA (2018b: 15) defines spread risk to arise "when the market value of assets and liabilities are sensitive to changes on credit spread over the risk-free interest rate terms structure" and with default risk arising "from potential losses due to credit default events" affecting a "financial instrument held by an insurer". Both components are designed to capture credit risk with each component covering mutually exclusive sets of assets. A funeral insurer's assets are limited to cash and was thus only affected by the default risk component.

The PA (2018b: 16) classifies three types of exposure to default risk which were rated instruments, unrated instruments and cash held at banking institutions. Only the last of these was relevant for a funeral insurer. The capital requirement is the decrease in the BOF due to an instantaneous decrease in cash arising from the default of a bank. (4.9) shows how to calculate the capital requirement. The Credit Quality Step (CQS) used in the calculation are shown in Appendix A.1 in Table A.1.

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[*] 0 if the nominal interest capital requirement is derived from applying a level increase to the interest rate structure and 0.5 if it is determined by applying the level decrease.
[†] 0 if the capital for the currency risk is derived from a risk of the Rand appreciating against other currencies and 0.5 if it derived from a depreciation.

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$$\sum_i cash_i \times factor_i \tag{4.9}$$

where $cash_i$ is the value of cash held at a bank with CQS i

$factor_i$ is the default risk factor for cash at a bank with CQS i

4.5.5.3 Concentration risk

The PA (2018b: 23) defines concentration risk as "the risk of potential losses on investments over and above the systemic risks arising from the portfolio of investments when the portfolio of investments is not sufficiently diversified." The concentrations referred to in this risk module were only with respect to counterparties.

The capital calculation is based on the excess exposures per counterparty, XS_i, which is calculated using (4.10). The concentration threshold, CT_i, for counterparties with CQS one to nine was 10% for cash held at South African Banks and 3% for all other exposures. Where the CQS of the counterparty was ten to eighteen, the thresholds are 5% and 1.5% respectively (PA, 2018b: 24).

$$XS_i = max\left(\frac{E_i}{Assets_{xl}} - CT_i; 0\right) \tag{4.10}$$

where E_i is the total default exposure to counterparty i

$Assets_{xl}$ is the total assets considered in the concertation risk module

CT_i is the concentration threshold to counterparty i

The capital requirement is then set equal to the decrease in BOF due to an instantaneous decrease in the value of E_i. The decrease in BOF is calculated using (4.11). The variable g_i depends on the CQS of the counterparty (PA, 2018b: 25). The values that g_i can take are shown in Appendix A.1 in Table A.2.

$$XS_i \times g_i \times Assets_{xl} \tag{4.11}$$

4.5.6 Operational risk

Operational risk is defined by the PA (2018f: 2) as "the risk of loss arising from inadequate or failed internal processes, people and systems or from external events" which "includes legal risk, but excludes risks arising from strategic decisions and reputational risk."

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The component, denoted as SCR_{op}, is calculated using (4.12). In the equation, Op denotes the operational risk requirement for all non-investment insurance obligations, while $Op_{investments}$ denotes the operation risk requirement for all investment insurance obligations. The latter does not apply to funeral insurance (PA, 2018f: 3).

$$SCR_{op} = min(0.3 \times BSCR; Op) + Op_{investment} \quad (4.12)$$

The Op component is the larger of the operational risk requirement using the earned premiums, denoted as $Op_{premiums}$, and is calculated using (4.13), and the operational risk requirement using technical provisions, denoted as $Op_{provisions}$ and is calculated using (4.14) (PA, 2018f: 3–4). In both equations, the non-life portion has been ignored.

$$Op_{premiums} = 0.04 \times Earn_L + max(0.04 \times (Earn_L - 1.2 \times pEarn_L); 0) \quad (4.13)$$

where $Earn_L$ is the earned premiums during past 12 months for non-investment life insurance obligations

$pEarn_L$ is the earned premiums during the 12 months prior to the past 12 months for non-investment life insurance obligations

$$Op_{provisions} = 0.0045 \times max(TP_L; 0) \quad (4.14)$$

where TP_L is the technical provisions for all non-investment life insurance obligations, excluding the risk margin

The operational risk requirement under SAM and Solvency II for the non-investment insurance obligations is identical. The method used to calibrate these requirements for SAM were not clear but are assumed to be based on the QIS's done in Europe. There are differences between the two regimes with regards to the calculation of the operational risk requirement for investment insurance obligations. Solvency II treats both investment and non-investment insurance obligations in the same way and adds an additional component to the requirement of 25% of expenses incurred during the previous 12 months (SAM Steering Committee, 2015d: 8). SAM does not have this component, but instead has a separate investment component for linked investment policies which was deemed more representative (SAM Steering Committee, 2015d: 14). Details of this calculation can be found in Prudential Standard *FSI 4.4: Operational Risk Capital Requirement*.

The method used to add the operational risk requirement to the BSCR (see (4.1)) implied that there was no diversification benefit between operational risk and all other risks. The Sam Steering

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Committee (2014a: 5) notes that this was consistent with the South African insurance solvency regulation that preceded SAM.

4.5.7 MCR

The MCR is a separate capital requirement. It is the minimum level of BOF that, if breached, will result in the strongest regulatory intervention (PA, 2018g: 4–5). This differs from the SCR which, if breached, will lead to different levels of intervention which depend on the extent of the breach with the strongest intervention occurring at the MCR point. The severity of the intervention is thus a stepwise function between the SCR and the MCR (PA, 2018g: 7).

The MCR is determined using a simple linear formula related to the scale of the insurer's operations. The measure is subject to an upper bound of 45% of the SCR and a lower bound of 25% of the SCR. It also has an absolute floor which is the greater of R15 million and 25% of the gross expenses in the previous 12 months (PA, 2018g: 3). These restrictions are shown in (4.15), (4.16) and (4.17) where $Op\_Expenses$ is the gross annual expenses incurred by the insurer (a more detailed definition is provided by the PA).

$$MCR = \max(MCR_{combined}, AMCR) \tag{4.15}$$

$$AMCR = \max(R15million, 25\% \times Op\_Expenses) \tag{4.16}$$

$$MCR_{combined} = \min(\max(MCR_L, 25\% \times SCR), 45\% \times SCR) \tag{4.17}$$

The MCR for life insurance obligations, denoted as MCR_L, is calculated using (4.18). Only two of the insurance obligations types were relevant to a funeral insurer. The first was for policies without profit participation (notated as $j = 3$) where $\alpha_{c.3} = 2.9\%$ and $C.3$ is set to the technical provisions of the policies. The second was for all policies with death, disability or health benefits (notated as $j = 4$) where $\alpha_{c.4} = 0.1\%$ and $C.4$ is set to the capital-at-risk for all policies (PA, 2018g: 4–6). The variables $C.1.1$ and $C.1.2$ relate to insurance policies with discretionary participation features. The variables $C.2.1$ and $C.2.2$ relate to insurance polices where the policyholder bears the investment risk. More details with regards to these factors and the calculation of the non-life components can be found in *Prudential Standard FSI 3: Calculation of the Minimum Capital Requirement*.

$$MCR_L = max\left(\sum_{Funds} max(\alpha_{c.1.1} \times C.1.1 + \alpha_{c.1.2} \times C.1.2; 0); WP_{floor}\right) + \sum_{j \in \{2.1, 2.2, 3, 4\}} \alpha_{c.j} \times C.j \tag{4.18}$$

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where WP_{floor} is the with profit floor set at 2%

$Funds$ is the product groups funds with discretionary participation features

$\alpha_{c.j}$ is the factor depending on type of insurance obligation j

$C.j$ is a value (such as technical provisions) to which the factor $\alpha_{c.j}$ is applied

The MCR was calibrated based on a value at risk of 85% (PA, 2018g: 3). The SAM requirement was based on the Solvency II requirement with a few adjustments. The first was to state the minimum amount in Rand and to add an additional minimum requirement of 13 weeks' expenses. It was not clear how the former was derived and the latter was based on the solvency regulation preceding SAM (SAM Steering Committee, 2015e: 1,11).

The division of the business between the various factors was also changed to be more specific to South Africa (SAM Steering Committee, 2015e: 1). The changes are not discussed in this thesis (the details of the change can be found in *Discussion Document 29 (v 8): Authorisation and reporting classes of business under SAM*). The formula was parameterised based on the results of the South African QIS3 (SAM Steering Committee, 2015e: 1).

4.5.8 Own risk and solvency assessment (ORSA)

ORSA makes up the second pillar of the SAM framework. It involves the insurer identifying and quantifying the risks it believes it faces – as opposed to the quantifications prescribed by the regulator under the capital requirements – and an outline of how it will respond if the risk event occurs (Insurance Regulation Committee, 2013: 19).

The SAM Steering Committee (2012: 17) defined ORSA "as the entirety of the processes and procedures employed to identify, assess, monitor, manage, and report the short and long term risks an insurance undertaking (and insurance group) faces or may face." Based on that, it needs to determine the amount of capital it needs to hold to meet its business objectives. ORSA also requires an assessment of the risk for a longer period than SAM. The sophistication of an insurer's ORSA should be proportional to the complexity of its business.

The purpose of ORSA was to ensure that the board and managers of an insurer are aware of the risks they face and have appropriate procedures in place to deal with them. The ORSA requirements are intended to be high level and principle based since a more prescriptive approach could lead to insurers omitting risks that should be included. It also emphasises the importance of risk management (SAM Steering Committee, 2012: 1,17).

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The ORSA requirements do not influence the regulatory capital requirements of an insurer (unless they make use of an internal model, in which case the capital requirements and ORSA results would come from the internal model). It has been included in this section for completeness.

Microinsurers will be subject to ORSA requirements as normal insurer, but these requirements are less onerous than for a normal insurer. The PA (2018h: 15) states that "the purpose of an ORSA is to ensure that the microinsurer meets the financial soundness requirements on a continuous basis, and has access to additional sources of capital if needed, to deal with a wide range of future scenarios." The microinsurer's board of directors will be responsible for compliance with the ORSA requirements set out in *Prudential Standard GOM: Governance and Operational Standard for Microinsurers Objectives* which was produced by the PA (2018h: 15). More details of the ORSA requirements can be found in that standard.

4.6 SUMMARY

This chapter provided the basis for the calculation of SAM capital requirement for a South African funeral insurer. Most of the risk calculation revolved around the life underwriting risk. As will be shown later, this portion made up the bulk of the SCR for the model microinsurer used in this thesis.

The fact that the formulae shown in this chapter, which were already fairly complicated, only makes up a small portion of all the SAM calculations emphasised how complicated the SAM capital requirement can be. This is in contrast to the much simpler formulae used to calculate the MICR. This is shown in the next chapter.

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CHAPTER 5
SOUTH AFRICAN MICROINSURANCE REGULATION

5.1 INTRODUCTION

The Insurance Act (2017a) which came into effect in 2018 introduced a separate license for microinsurers. An insurer would qualify for such a licence if it met certain conditions. The most important conditions from a capital modelling perspective is that the sum assured is less than R50 000 for a life insurer and that the contract boundary does not exceed 12 months (FSCA, 2018a,b).

The chapter will outline how the special microinsurance licence came about. This will involve a brief description of the regulation in its current form and how this has changed over time. An overview of the product restrictions specified in the policyholder protection rules will be provided. A detailed description of the financial requirements of a microinsurer under licence is then presented. The chapter will conclude with a high-level discussion on some of the feasibility issues of the new regulation.

5.2 NEW REGULATION

The issue of microinsurance specific regulation was raised in South Africa in the early 2000's after parliamentary hearings in 2003 and 2005 with regards to abuses in the funeral industry. The first proposal for a South African microinsurance specific regulation was in 2008 with the release of a policy document by the National Treasury (Endres *et al.*, 2014: 21). The goal of this policy document was to create a regulatory framework that ensured good value products for low-income consumers and provided them with adequate protection (National Treasury, 2008: 6).

The policy document proposed several ways in which insurance could be written under the new proposed regulatory framework, namely through burial societies, by outsourcing the underwriting to a registered insurer, as a cell captive, by existing insurers or under a new proposed microinsurance licence (National Treasury, 2008: 8). The initial proposal was to introduce separate legislation to regulate the microinsurance field (National Treasury, 2008: 12).

The goals at the time included, amongst others, to ensure protection of consumers and the development of the industry. This development included allowing more small businesses to be involved and to bring illegal providers into the formal economy (National Treasury, 2008: 17–18). This however leads to a compromise being required. The protection of consumers demands strict regulation, including with regards to the capital requirement. Inclusion of small business demands low barriers to entry in terms of capital requirements, amongst other regulatory concessions.

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The National Treasury released a second document in 2011 setting out the proposed regulatory framework based on the discussion paper and feedback from consultations with both formal and informal providers (Endres *et al.*, 2014: 22). This policy document included the goals with regards to ensuring consumer protection and low barriers to entry, amongst others, set out in the 2008 policy document (National Treasury, 2011: 3–4; Endres *et al.*, 2014). The importance of having a dedicated microinsurance licence was emphasised in the policy document.

To receive a licence an insurer would be limited to selling products that adhere to certain restrictions, need to meet certain registration requirements, need to separate the insurance business from other operations, adhere to certain reserving and capital standards and require actuarial sign off on the pricing of the products (National Treasury, 2011: 20–29; Endres *et al.*, 2014).

There were, however, several changes to the South African insurance regulatory regime after the release of the 2011 policy document. These include the movement to the twin peaks regulatory system and the introduction of SAM and treating customers fairly regulation. It was thus decided by the National Treasury to incorporate the microinsurance regulatory framework into the Insurance Act (2017a). Thus, the dedicated licence came into being at the same time that SAM was implemented. The microinsurance regulatory framework that eventually became law is still similar to that proposed in the 2011 policy document.

As at the time of writing, no South African insurer had yet received a microinsurance licence according to the list of registered insurers produced by the PA.

5.3 CONTRACT RESTRICTIONS

The latest contract restrictions for a South African microinsurance product were specified in two amendments by the FSCA (2018a,b) in Government Gazette number 22 of 2018. These specified the conditions that any insurance policy sold by a licenced microinsurer must meet. Further, it also states that only a licensed microinsurer can refer to their policies as microinsurance products.

A description of the contract restrictions applicable to a microinsurance policy is shown in Table 5.1. Further to these contract restrictions, the FSCA (2018a,b) also requires a microinsurer to notify it at least 31 day before introducing a new product to the market and provide the following information:

- the benefits to be provided and any exclusions;
- the terms and conditions of the new product;
- the proposed commission payable and the structure thereof; and
- the marketing material intended to be used in selling the new product.

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Table 5.1: Contract restrictions for South African microinsurers

Policy condition	Microinsurance contract restriction
Contract term	The contract term (or boundary) cannot exceed 12 months.
Sum Assured	The sum assured is limited to the amount specified by the PA. This is, at the time of writing, R50 000 for life insurance and R100 000 for general insurance. Further, if the microinsurance policy benefit is not expressed as a sum of money, then the policyholder may demand the rand value of the benefit in place of the benefit expressed in the contract.
Waiting period	A waiting period for a microinsurance product cannot exceed a quarter of the policy term in respect of benefits payable on death, disability or a health event. The waiting period must also be waived if death, disability or a health event occurs due to an accident. Further, a waiting period cannot be applied to a policy that is being renewed. It also cannot be applied to a customer with a similar policy at another microinsurer before entering the new contract and has already served out a waiting period under that policy. If the waiting period in the previous policy was not completed, then the microinsurer may set a waiting period equal to the time period of the previous waiting period not yet completed.
Exclusions	For funeral insurance policies, no exclusions can be applied for pre-existing conditions other than through the waiting period. The exception is for suicide which can be excluded for up to 12 months after the contract’s inception. There are various accepted exclusions for general microinsurance policies. These are in line with normal general insurance exclusions such as wear and tear and unlawful conduct.
Reinstatement	If a policy lapses due to non-payment of premiums and the microinsurer chooses to reinstate the policy after payment of premiums by the life assured, then the same terms as the policy that had lapsed must be applied and no new waiting period may be applied. If the microinsurer enters into a new policy with the life assured within two months of the lapse of the previous policy, then the microinsurer can also not impose a waiting period longer then the unexpired portion of the lapsed waiting period.

Source: FSCA, 2018a,b

5.4 INVESTMENT RESTRICTIONS

A microinsurer, unless granted permission by the PA, can only invest in cash, cash equivalents and investment funds restricted to money market funds. In addition a microinsurer can only invest up to 25% of the assets backing the liabilities and capital requirement in any one financial institution with any amount in excess of this not being recognised by the PA (2018e: 7).

The intention of these restrictions was most likely to minimise liquidity risk, ensure the assets were held in safe investments to protect policyholders and to lower default risk. Some of these restrictions may have practical issues. For example, the requirement to hold no more than 25% of assets at any financial institution means the insurer will need accounts at least four banks to meet this criterion. The practicality of such an arrangement is somewhat questionable.

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5.5 FINANCIAL SOUNDNESS REQUIREMENTS

The financial requirements, in terms of the technical provisions that need to be set aside, and the additional capital required to support the insurance liabilities, have changed only slightly since they were first proposed. The two notable changes are that the minimum capital floor has increased from R3 million to R4 million and the requirements are now part of the SAM framework. The SAM framework now includes separate guidance notes for microinsurers on the financial soundness requirements. These are fairly simplistic and highly prescriptive requirements designed to be proportional to the risk that a microinsurer would face to encourage formalisation and lower barriers to entry (National Treasury, 2008: 18; Endres *et al.*, 2014: 23; PA, 2018e).

5.5.1 Technical provisions

The microinsurance regulation requires a microinsurer to set up four types of technical provisions*. The Financial Soundness for Microinsurers (FSM) guidance note sets out how these should be calculated, although there is scope to apply to the regulator to calculate these using a different method. The regulator may also, if deemed necessary, require the microinsurer to use a different method (PA, 2018e: 4).

The first technical provision is the Unearned Premium Reserve (UPR) which is the amount of premium income received which corresponds to the period of cover that has yet to pass. The UPR must be calculated on a per policy basis using a prescribed formula (see (5.1)) and then summed across all policies (PA, 2018e: 4–5).

$$UPR = (A - B) \times \left(1 - \frac{C}{D}\right) \tag{5.1}$$

where A is the sum of gross premiums for the whole period

B is the sum of policy refunds, reinsurance premiums paid, net commission and outsourcing fees payable for the whole policy period

C is the number of days from the commencement of the policy until the valuation day

D is the total number of days in the whole policy period

* The regulation refers to the four types collectively as technical provisions, but calls some of them reserves and thus uses the terms provisions and reserves interchangeably as is common actuarial practice. The thesis has endeavoured to only using the term technical provisions for consistency, except where referring to the microinsurance technical provisions where the name of the provision in the regulation has been used.

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The second is the Outstanding Claim Reserve (OCR) which is the amount the insurer expects to pay in the future with regards to claims that have been reported but not yet settled. The regulation requires the microinsurer to calculate this provision on a market consistent basis which can be done using either judgment or statistical methods to project these expected losses (PA, 2018e: 5).

The third is the Incurred But Not Reported Reserve (IBNR) which is the claim amount expected to become payable in the future from claims that have been incurred, but have yet to be reported to the insurer. It should be set to at least 7% of the premium income earned in the 12 months preceding the valuation date (PA, 2018e: 5). The PA can require or approve a different percentage.

The last technical provision is the Unexpired Risk Provision (URP) which is only held if the microinsurer expects future claims and expenses to exceed the UPR and is set to the size of this excess. The regulation requires the microinsurer to calculate this technical provision on a market consistent basis which can be done using either judgment or statistical methods to project these expected losses (PA, 2018e: 5–6).

5.5.2 Capital requirements

The MICR is a simple measure which is calculated as the greater of 15% of the net premiums[*] written in the previous 12 months or the 12 months preceding that. Additional requirements may be imposed by the PA should the microinsurer wish to invest excess assets in asset classes different to those described in Section 5.4. The capital requirement was also subject to a minimum, as stated above, of R4 million (PA, 2018i: 4).

This minimum capital requirement appears to be based on the short-term insurance capital requirement that was applicable at the time of the 2008 policy document (National Treasury, 2008: 95). The rationale for the increase in the minimum capital requirement was not discussed in the sources used in this thesis.

It was not clear to which level of protection the MICR was calibrated. However, assuming that the regulator would want consistent treatment of different insurers, it was assumed that the MICR was also designed to survive a 1-in-200 year event.

According to the PA (2018i: 5), the breaching of the MICR will likely lead to the strongest regulatory intervention. The PA will initiate the intervention if it believes that the insurer has failed

[*] The PA (2018i: 4) defines net written premiums for a microinsurer as “the total amount of all the premiums payable for the whole policy contract term to the microinsurer under policies entered into by it in the respective 12 month period net of eligible reinsurance premiums”. The net written premium also includes the portion paid as commission.

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or may fail to meet this requirement in the next three months. However, the PA (2018i: 5) also states that it will commence with regulatory action at an earlier stage if it believes the microinsurer is at risk of breaching the MICR within the near future.

5.5.3 Building up capital requirements

In light of the regulatory goal to lower barriers to entry, the regulation allows a microinsurer to build up its capital over several years to reach the minimum requirement. The regulation allows the microinsurer to start with R1.5 million upon registration and then needs to add R0.5 million each year over three years to meet the minimum requirement. The microinsurer would have to specify how it plans to build up its capital to the minimum requirement (National Treasury, 2011: 27–28). It was not clear how this approach would change in light of the new higher minimum capital requirement.

5.5.4 Actuarial involvement

The framework initially proposed does not require a microinsurer to appoint a statutory actuary who would need to sign off on the actuarial valuation of the microinsurance product. Instead, an actuary would only be needed to sign off on the pricing of the product (National Treasury, 2011: 29).

The role of the actuary has however been significantly expanded since the introduction of the Insurance Act (2017a). The microinsurer will be required to appoint a head of actuarial function which will need to comment on the adequacy and reliability of both the technical provisions and the calculated capital requirement. Further to this, they will also need to comment on the actuarial soundness of all insurance products sold by the microinsurer (PA, 2018j: 6).

5.6 FEASIBILITY CONCERNS

The much simpler approach to regulating financial soundness should be a great advantage to start-up microinsurers which may not have the expertise to prepare the requirements in line with SAM. It may also encourage some informal microinsurers to register for a licence. Similarly, the lower capital requirement may also make registration more feasible for such businesses.

Bowman (2014) considered a case study where a funeral administrator investigated the feasibility of applying for its own microinsurance licence. He found that the microinsurer would unlikely be able to meet the absolute minimum capital requirement without a significant capital injection. This also meant that the return on equity would be very small which may not make it worthwhile to operate. The funeral administrator was not particularly small as it was administering 30 000 policyholders at the time of the assessment. Given that the survey by CENFRI (2013) showed that nearly 85% of the informal microinsurers had less than 3 000 policyholders, it seems unlikely that the license will appeal to most informal microinsurers.

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The expansion of the role of the actuary at a microinsurer also meant that the administration cost would likely go up as the actuary would need to be compensated for the additional work performed. This cost can be substantial for such small microinsurers. It was thus somewhat debatable as to whether the microinsurance licence would meet the goal of encouraging formalisation.

5.7 SUMMARY

This chapter provided the basis for the calculation of the MICR. It was clear that this approach was much simpler than the SAM SCR calculation. It was also clear that the capital requirement was not based on the risk profile of the microinsurer as the SAM SCR was. There was thus more risk for the regulator in allowing an insurer to follow such a simplified approach as opposed to SAM. It was thus important to be able to compare just how different the two capital requirements for a microinsurer would be.

The next chapter provides a review of some of the approaches which can be used to compare capital requirements.

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CHAPTER 6
COMPARING CAPITAL REQUIREMENTS

6.1 INTRODUCTION

There are several approaches to compare capital requirements under different solvency regimes. One approach is to simply compare the different requirements in terms of the rules and principles specified under each solvency regime. This was the approach followed by Lindberg and Seifert (2015) who compared the US RBC and Solvency II. It was also followed by Eling and Holzmuller (2008) who used it to compare the New Zealand and Swiss approach in addition to the two mentioned previously. These two papers, and this approach in general, can provide useful insights into how the principles behind the capital requirements differed. These comparisons are however limited as the significance of the differences are not quantified.

Thus, of greater importance for this thesis were comparisons that were quantitative in nature. Two general approaches were identified in literature with regards to quantitative comparison. The first was to compare the actual calculated capital requirements under the solvency regimes being compared. This is discussed in Section 6.2. The second was to compare the risk of insolvency for an insurer when it is holding the specified amount of capital. This is discussed in Section 6.3.

6.2 COMPARISON OF NOMINAL CAPITAL REQUIREMENT

Comparing the nominal capital requirement values under two regimes sounds like a fairly straightforward process. However, since no two insurers are the same, it is not generally appropriate to pick just one insurer from the market and compare the capital requirements. One approach would thus be to compare the capital requirement for all the registered insurers, for example all life insurers in South Africa.

This was the approach taken by Kendal and McLeod (2004) who compared the US RBC and the Australian capital requirements as applied to each medical aid scheme registered in South Africa. This required gathering information for each medical aid scheme to apply the formulas under the two capital requirements and approximations where no information was available. This approach was however not feasible for microinsurers in South Africa due to the lack of granular data. This data would be required to firstly split out the microinsurance portion of each insurer since nearly no South African insurers wrote pure microinsurance business. Secondly, other detailed data would also be required to calculate the capital requirement under SAM. This includes data, on a

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per policyholder level[*] with regards to assumed mortality rates, sums assured, lapses and so on. These are generally not available in published financial statements.

An alternative approach is to build a model insurer to represent the industry average. This was the approach taken by Sharara, Hardy and Saunders (2010) to compare the Canadian MCCSR, the US RBC and Solvency II. They modelled a simplified insurer to compare the three solvency regimes. This approach was considered more suitable for this thesis since there was sufficient aggregate industry data available to build a model microinsurer. Building a model microinsurer also has the advantage of being easily extended to allow for testing the rate of insolvency under the capital requirements.

6.3 COMPARISON OF INSOLVENCY RATES

A natural approach to compare the insolvency rates for different capital requirements would thus be to fit statistical distributions to the model insurer. However, there were other approaches to such comparisons.

One such approach by Dror and Armstrong (2006) involved using historical policyholder data from a large insurance health scheme. This involved allocating policyholders randomly to different sized insurers, calculating the premium income of the insurer (based on the average cost of claim across all policyholder data) and then subtracting the actual policyholder claims. The rate of insolvency is then calculated by assuming each insurer holds a certain amount of capital. The allocation approach is then repeated so that there is a large number of simulations. The advantage of this approach is that it relied on actual policyholder data and not theoretical loss distributions. The disadvantage was that it only dealt with claims risk and ignored most of the risks which the capital requirement is designed to protect against. It was thus not deemed a suitable approach for this thesis. This approach also requires detailed policyholder data.

Another approach is to compare the number of insurers that fall below the capital requirement threshold over a defined period to the actual number of insurer insolvencies that occur in that period. This was the approach taken by Cummins and Phillips (2009) which compared the insurer insolvency rate in the US over a five year period with the proportion of companies that fell below the regulatory minimum. The main issue with using this approach in this thesis is that there are currently no insurers registered under the microinsurance license and thus no historical insolvency data. It also provides limited information on the type of risks that the requirements do not adequately allow for.

[*] There may be grouping of similar policyholders before the SAM calculations are performed.

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6.4 SUMMARY

The two quantitative approaches were deemed useful in comparing the MICR and SAM SCR and were thus implemented in this thesis. To compare the nominal value for the capital requirement a model insurer was created.

To compare the insolvency rates, and thus the adequacy of the capital requirements, it was decided that stressing the model using deterministic and stochastic methods would be most appropriate. However, none of the literature reviewed on comparing capital requirements provided a suitable approach to do this. Instead, it was determined that the methods used in economic capital requirements for microinsurers provided a good framework for such an approach. The literature surrounding capital modelling is discussed in the next chapter.

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CHAPTER 7
CAPITAL MODELLING

7.1 INTRODUCTION

A capital model plays an important role for many insurers and plays a pivotal role in most insurers' capital management strategy. This has become even more important with the introduction of ORSA practices. The financial crisis of 2008 has also resulted in a greater focus on risk and capital management in most of the financial industry (Farr, Koursaris & Mennemeyer, 2016: 39–41).

An insurer's capital model or models can be built for a variety of reasons. This could be for internal purposes such as business decisions, strategic development, capital allocation, capital management or risk management. It could also be for external purposes such as providing information to rating agencies, regulators, shareholders or other interested stakeholders. The models tend to only be useful for an insurer if it allows for all the features relevant to that specific insurer. As a result, much of the literature on capital modelling assumed that the user of the literature had detailed information on the insurer that was being modelled (for example, detailed information regarding the lives assured, policy conditions, assets that the insurer held and so on) when discussing ways to build a capital model. This was not the case for the model insurer used in this thesis which was based on the average insurer in the funeral insurance industry.

This meant that the focus of this chapter was the underlying principles of capital modelling found in literature. Adhering to the principles when building the capital model would ensure that the model was consistent with that found in literature. A high-level description of the approach that should be taken when building a capital model to ensure the principles are adhered to is discussed in Section 7.2.

The main aim of this literature review was to provide a framework for testing the adequacy of the two capital requirements for microinsurers. This was generally performed in two ways. First was to specify in some way the level of risk the insurer is willing to tolerate (for example, the level of insolvency risk the insurer deems acceptable) and then determine the amount of capital the insurer must hold to meet this requirement. The adequacy of the capital requirement will then depend on the chosen level of risk tolerance.

The second is to test how much protection against insolvency is provided by the capital currently held by the insurer. The level of protection could be based on the results of a statistical test (for example the probability that a loss exceeds the capital held) or a deterministic test (for example testing to see which combination of variable changes results in a loss that exceeds the capital requirements).

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The latter of the two approaches was the one of interest in this thesis as this could be used to assess the level of protection of a capital requirement. The methodologies used to carry out this approach are discussed in Section 7.3.

7.2 ECONOMIC CAPITAL MODELLING

A capital model built for an insurer is often based on the insurer's economic capital. The model is generally used to determine the insurer's required economic capital. Required economic capital is how much capital an insurer should hold so that it can meet future obligations with a certain probability. This should be based on an economic perspective, i.e. the amount of capital the insurer believes it needs to hold based on its assets, liabilities, business objectives and the probability of insolvency that is acceptable to the insurer. This requirement could, and often does, differ from the minimum amount specified by the regulator. (Finkelstein, Hoshino, Ino & Morgan, 2006: 4; Kapel *et al.*, 2013: 1–2; Farr *et al.*, 2016: 6).

The required economic capital modelling approach can be reversed to calculate the level of protection provided by the regulatory solvency capital. Instead of stating the acceptable probability of insolvency and calculating the capital required in the model, the capital held is stated in the model and the probability of insolvency is calculated. This approach was used in this thesis and is discussed in Chapter 10 and 11. It was important that the approach was based on sound capital modelling principles to ensure that the results produced were reasonable.

7.2.1 Principles of economic capital modelling

The North American Chief Risk Officers (CRO) council (2013) proposed a list of twelve modelling principles. Some of these principles were that the capital model should reflect the particular aspects of the insurer. The principles of interest for this thesis, however, were those that were broader in nature and would be applicable to a generic insurer model. These are shown in Table 7.1.

These principles included the need to build the model around the purpose, the need to use stress testing to determine the greatest risk to the model insurer and the need to find the right balance between making simplifications and ensuring the model represented the real world. The other principles were considered less important for this thesis.

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Table 7.1: Selected North American CRO Council capital modelling principles

Principle	**Description of the principle**
Design should be driven by its purpose	The purpose of the model must be clearly defined. The methodology used to build the model should then be chosen based on this purpose. The purpose will influence the factors that the model should account for and the required output of the model. Often a model will have more than one purpose in which case it is important that the model is flexible enough to produce appropriate outputs for each purpose.
Development should be an iterative process	The model should be continually refined and updated as new information becomes available over time. This new information can be used to update the model to ensure it is still representative of the insurer.
Stress testing should be an integral part	Stress tests, which look at a single or a combination of adverse events, can be used to validate the model by applying an historical stress to the model and compare the model outcome with the actual impact of the stress. They can be used to recognise the greatest risk to the insurer and get insight into the risk profile of the insurer.
Should be validated	It is important that the model inputs, calculations, and outputs are verified. It is preferable that this is done through an independent review of the model. The extent of the validation process should be proportionate to the complexity of the model and the importance of its use.
Limitations should be identified	Any limitations to the model should be clearly documented and the expected impact on the results of the limitations should be estimated. Limitations often arise from a lack of data which means that expert judgement needs to be relied on instead. It is very important to document such situations.
Balance between realism and pragmatism	It is important that the model captures the main risks to the insurer in as sufficient detail as is proportionate to the complexity of the risk and importance of the model. However, it is not necessary for the model to capture every single detail of the risk and the insurer’s operations. Modelling in too much detail will use up time and resources with little benefit.
Conclusions and results should be understood	The model should not be treated as a black box, meaning that the results should not be accepted just because the model says so. It is important to understand the logic behind the model result so as to check the reasonableness of the results.

Source: North American CRO Council, 2013: 6–7

7.2.2 Building an economic capital model

The approach that literature suggests should be followed when building a capital model was generally presented as a series of modelling decisions that had to be made. The type of decision made would depend on the level of data available, the business being modelled and the purpose of the model. The limited data available for the model used in this thesis meant that the decisions made when designing the model were mostly guided by pragmatism. The decisions that need to be made are outlined below (the technical details of constructing a model are not discussed here as they would depend mostly on what was being modelled).

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7.2.2.1 *What are the objectives of the model?*

The first aspect of any model building process is to clearly define what the objective of the model is. Farr *et al.* (2016: 12) stated that it was important that these objectives are reflected in the capital model and that the objectives should represent the insurer's realistic behaviour and the business plan they intend to follow. Ultimately, the design of the model, such as the calculation methods used and the parametrisation, will depend on the objective of the model. (North American CRO Council, 2013: 8–9)

It was also possible to have multiple objectives. It is important that the model is flexible enough to achieve all the objectives. An example of dual objectives was presented by Crozet (2008) who argued that capital modelling and insurance pricing should be integrated due to the close links between the two which are often ignored in practice. Changes would be required in the way the model is designed to incorporate more than one objective. This would generally be in terms of the data input required, the calculations performed and the output of the model.

7.2.2.2 *What elements should be included?*

The next decision relates to which elements should be included in the model and how to incorporate them. This will depend on the objectives that have been decided and on the available data. The elements that generally need to be chosen are the different cashflows such as premium income, claims outgo, insurance expenses, investment income, reinsurance premiums and recoveries, tax, dividends and so on.

It was also important to decide which sources of cashflows should be included in the business. An important consideration mentioned by Farr *et al*. (2016: 17) for model projections was whether new business should be included in the model or not. Not allowing for new business can underestimate the insurer's risk since writing new business uses up capital. Thus, the capital may seem to be sufficient for the business currently in-force, but not when allowance is made for the new business written. The risk is also greater for longer-term projections where there is much more uncertainty regarding the amount of new business written.

7.2.2.3 *The time horizon of the model?*

After deciding which elements to include, a decision needs to be made as to how far in the future to project the different elements. The further the model projects into the future, the greater the uncertainty with regards to the outcome. Therefore, the further into the future the projection goes, the larger the capital requirement will be for the same confidence level and risk measure, all else being equal (Farr *et al.*, 2016: 15). A longer period is also more complex to model and will require more simplifying assumptions (Finkelstein *et al.*, 2006: 31–32).

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Finkelstein *et al*. (2006: 33) and Kapel *et al*. (2013: 22) claimed that a one year time horizon was the most commonly used. An issue with this appoach, as noted by Finkelstein *et al*. (2006: 33) is that a change in a factor in the one-year period may affect cashflows outside that period. This could result in a major component of the risk being missed in the projections.

There is a movement to ORSA requirements in many capital regimes which does require the insurer to look at a longer period than one year (see Section 4.5.8). This should mitigate this risk to some extent.

7.2.2.4 What risks should be included in the model?

The next descision is which risks should be allowed for in the model. Farr *et al.* (2016: 30–38), Finkelstein *et al.* (2006: 14–17) and Kapel *et al.* (2013: 13–15) each discussed the different risks that could be included in the model. These can broadly be categorised as underwriting or insurance risk, market risk, credit risk, operational risk and liquidity risks. The different risk areas that applied to the model insurer in this thesis were described with the SAM regulatory requirements (see Chapter 4).

7.2.2.5 How should the risks be measured and aggregated?

The next step involves measuring the risks that have been included. The risks can be quantified by using a risk measure. There are numerous types of risk measures that can be used. The two most common risk measures used in practice are VaR and TailVaR (Finkelstein *et al.*, 2006: 24; Kapel *et al.*, 2013: 12; Farr *et al.*, 2016: 30).

The VaR is defined as the maximum loss, over a specified period of time, at a specified probability (Szegö, 2002: 1257). Mathematically, it is defined as follows. If X is the random variable representing the distribution of the insurer's profit and $1 - c$ is the specified probability of the loss, the VaR is the negative value of the cumulative distribution of X at quantile c. This is shown in (4.17) (Szegö, 2002: 1258).

$$VaR_c = -F_X^{-1}(c), \qquad 0 \leq c \leq 1 \tag{7.1}$$

Kapel *et al.* (2013: 13–15) notes that VaR is a simple concept that is easy to use and communicate. It also requires less detailed analysis of the tail of the distribution of losses which means it is easier to implement in practice. However, the measure ignores high risk, low probability events (i.e. those in the tail of the distribution) and thus may not provide adequate protection against extreme events (Finkelstein *et al.*, 2006: 24; Kapel *et al.*, 2013: 12).

The TailVaR (also referred to as the conditional tail expectation) is defined as the expected loss over a defined time period given that the losses have exceeded a specified quantile of the loss

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distribution (Kapel *et al.*, 2013: 13). Mathematically, it is the expected value of X given that the loss had exceeded the value of X_c, where $F_X(c) = X_c$. This is shown in (4.17).

$$TailVaR_c = E(X|X < X_c) \tag{7.2}$$

It is generally considered a superior measure as it deals better with tail risk (Szegö, 2002: 1263; Finkelstein *et al.*, 2006: 25; Kapel *et al.*, 2013: 13). However it is also computationally more intensive and suffers more from data problems than VaR due to the limited data available for parametrising the tail of the loss distribution (Finkelstein *et al.*, 2006: 25; Kapel *et al.*, 2013: 13).

7.2.2.6 What method should be used to calculate the capital requirement?

With a risk measure chosen, it is now possible to determine a suitable capital requirement using the model. The capital requirement can generally be determined using three different approaches (Finkelstein *et al.*, 2006: 26; Kapel *et al.*, 2013: 18; North American CRO Council, 2013: 13–14; 2016: 17–22). The first is to apply individual shocks to each variable, determine the size of the loss from each shock and then combine the losses – preferably allowing for the diversification benefits – in some way. The second was to determine a set of assumptions that represents an adverse scenario and determine the loss from such a scenario. This can be repeated for various scenarios and the capital requirement can be based on some combinations of these losses. The final approach is to model the risks stochastically and apply a risk measure to the distribution to determine the size of the loss at a certain confidence level. These tests are discussed in more detail in Section 7.3.

7.2.2.7 How should the results be validated?

The final step is to validate the model. This is an important part of the process as it can help to identify errors in the model. An error in a model can lead to the wrong decisions being made which can be detrimental to the insurer. The North American CRO Council (2012: 9) stated that model validation can be applied to three components of any model: the inputs, calculations and the outputs. Several different tests can be performed for each component.

The inputs consist of the data and assumptions used in the model. The data can be validated by reconciling the data, for example between that used in the model and the administration system or the financial statements of the insurer. The data and assumptions could also be compared to any benchmarks that are available. Judgement from an independent expert could also be used to assess the reasonability of the input assumptions (North American CRO Council, 2012: 10–11).

The calculation component are the processes that turns the inputs into outputs. Sensitivity tests can be performed by varying the inputs and determining the impact on the outcome of the model.

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The reasonability of the changes should then be assessed. If a change seems unreasonable, then this may indicate an error in the calculations (North American CRO Council, 2012: 11–12).

The outputs are the results of the calculation used in the model. One method to test the results is back-testing. This involves using past data as input to the model (preferably data that was not used in calibrating the model), determining the outputs and comparing this to actual past experience.

7.3 DETERMINING THE ECONOMIC CAPITAL REQUIREMENTS

The most important capital modelling step for this thesis was the decision described in Section 7.2.2.6 regarding how to determine the capital requirement. Setting the requirement is based on level of protection chosen by the insurer. This meant that this process can be altered for the purposes of this thesis, namely to determine the level of protection for a given capital requirement. The test described in this Section thus provided the framework used to determine the adequacy of the SAM SCR and MICR.

Farr *et al.* (2016: 17) and Kapel *et al.* (2013: 9–12) highlighted the two most common approaches used to determine the required level of economic capital. The first was the liability run-off approach in which the required capital is the amount that should be held to pay all future claims and expenses of existing business until they go off the insurer's book. The second is the finite risk horizon which is the amount of capital that an insurer should hold to meet all future claims outgo and expenses, for both existing and future business, over a defined period of time. The capital required under both approaches is calculated based on a specified confidence level of meeting the claims and expenses outgo of the insurer.

There are advantages and disadvantages to both approaches. Farr *et al*. (2016: 21) discusses these for each approach. The run-off liability approach takes a long-term view on the insurer's business compared with the finite risk horizon (although this will depend on the horizon used). The approach gives a long-term view of the development of insurance liabilities which may be more appropriate for the long-term nature of life insurance. This puts the focus on the long-term insurance risk when deciding the capital requirements. This seems appropriate as it is the risk that the insurer will likely spend most of its time managing. Market risk is generally modelled using a fairly simplistic approach due to the difficulty in modelling the market risks over such a long period. However, market risk does play a major role in the insurer's ability to meet its liabilities and it is thus a weakness of this approach (Farr *et al.*, 2016: 21).

An advantage of the finite risk approach discussed by Farr *et al*. (2016: 27) is that it is generally easier to calibrate the economic capital requirement as there is normally more data available for the shorter periods that are generally modelled under such an approach. A disadvantage of this

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approach is that it may underestimate the impact of long-term risks as the consequences of these risks may only occur after the end of the modelling period.

Once an approach has been chosen, deterministic or stochastic methods can be used to determine the adequate amount of capital to be held. Alternatively, as used in this thesis, these methods could be used to determine the level of protection provided by the capital held by the insurer. The method used will depend on the data available and the risk measure chosen by the insurer (Finkelstein *et al.*, 2006: 25–26; Farr *et al.*, 2016: 13).

The remainder of this section will focus on the methods used by an insurer following the finite risk horizon approach and one that uses VaR as its risk measure as this corresponds with the SAM capital requirements.

7.3.1 Deterministic methods

The deterministic methods used are generally referred to as stress tests. The stresses can be applied to variables individually or collectively (North American CRO Council, 2013: 13; Farr *et al.*, 2016: 13). There are two ways to apply stresses to individual variables. The first is applying pre-specified shocks to the modelled variables individually and then determining the impact on the insurer's capital level (Kapel *et al.*, 2013: 18). The second is reverse stress testing which is used to determine how adverse a movement in a modelled variable must be for the insurer to be deemed insolvent (North American CRO Council, 2013: 14). Stressing variables collectively involves designing adverse scenarios. The impact they have on the insurer's capital requirements is then determined.

It is often not possible to assign a probability of the insurer going insolvent using a deterministic method. This is because these methods do not give a statistical distribution of the results unless a probability is specified for each individual shock or scenario. The conclusion with respect to the level of protection provided will thus often be qualitative as opposed to quantitative. For example, it may be concluded from a test that "we hold sufficient capital to survive a type A scenario but not a type B scenario".

7.3.1.1 Shocking individual variables

The first deterministic method, shocking individual variables, requires appropriate stresses for each risk variable. The shocks are often calculated based on some confidence level. The losses calculated under each stress type are then combined using an aggregation method (such as those discussed in Section 3.4.2) which can then be set as the capital level.

This approach is used to calculate the SAM SCR. This means that it would not be appropriate to use this method to test the adequacy of the capital requirements in this thesis. This is because the same method would be used to test the capital requirement as was used to set it. The capital

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requirement would then naturally be deemed adequate if it was assumed that the underlying shocks used in the SCR calculation are correct.

7.3.1.2 Reverse stress testing

Reverse stress testing involves determining an adverse outcome, such that loss equal to the capital held, and then working backwards to determine what could cause a loss of such a magnitude (Insurance Regulation Committee, 2013: 14; North American CRO Council, 2013: 14).

Reverse stress testing is a useful way to understand the severity of the different risks the insurer faces (North American CRO Council, 2013: 14). Those variables that require the smallest change in value to result in the insurer becoming insolvent would generally be where the greatest risk lies. However, just considering the percentage change may not be appropriate. The likelihood of a variation occurring is also an important consideration. If one variable is more likely to vary by the percentage that would result in the insurer becoming insolvent than another variable, then this variable would be the greater risk for the insurer.

7.3.1.3 Scenario analysis

Scenario analysis involves determining a set of assumptions that represent some future outcome, which is generally due to adverse experience (Finkelstein *et al.*, 2006: 26). The Insurance Regulation Committee (2013: 1) defines a scenario as a "consistent future state of the world over time, resulting from a plausible and possibly adverse set of events or sequences of events". They categorise scenarios that can be used by insurers into two types.

The first is historical scenarios which are based on past events. The consequences of the event can be determined from past data which can be adjusted to infer the consequences to the insurer's capital were the event to occur in the future. However, determining an appropriate adjustment such that the effects of the scenario accounts for changes in the economic and regulatory environment can be very difficult. This is due to the numerous and complex changes that the economic and regulatory environment experiences over time (Insurance Regulation Committee, 2013: 14–15).

The second type is synthetic scenarios which are based on hypothetical conditions. These scenarios are easier to tailor to the specific circumstances and can include risks which were not present in the past. They will normally be specified by looking at the particular risk a company faces to see what scenarios can lead to the realisation of these risks. They are, however, fairly subjective which may make them more difficult to justify and communicate (Insurance Regulation Committee, 2013: 15).

After the scenarios have been chosen, the effect on the firm's balance sheet is calculated for each scenario. The main item of interest will be how the excess of the assets over liabilities changed

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under the set of assumptions from the chosen scenario as opposed to the best estimate of those assumptions. This will indicate the size of the loss the insurer has made as a result of the scenario.

7.3.2 Stochastic analysis

Because a deterministic scenario does not generally provide a statistical distribution of the results, this approach is incompatible with the use of risk measures such as the VaR (Finkelstein *et al.*, 2006: 25–26).

A stochastic approach, however, does result in a distribution of results. It involves specifying a probability distribution for each assumption. Analytical methods could then, in theory, be used to determine the distribution of the insurer's net profit based on how the input distributions are combined. However, determining such a closed form solution is often unfeasible or impractical. Simulation methods are thus generally used, such as the Monte Carlo method. This involves generating random values from each distribution. These are then combined, allowing for any correlations, to determine the net profit. This is repeated for many simulations resulting in a distribution of outcomes from which percentiles and other required summary statistics can be derived (Finkelstein *et al.*, 2006: 25; Farr *et al.*, 2016: 13).

This is conceptually similar to the scenario analysis with the exception that many more scenarios are normally tested. The scenarios are also not specified but simulated from statistical distributions. This eliminates some of the subjectivity introduced in choosing scenarios and can also result in testing material scenarios that were not thought of by the model designers. It does however introduce subjectivity, and possibly spurious accuracy, due to the need to specify a distribution for the assumptions.

7.4 SUMMARY

This chapter provided the framework used to test the adequacy of the two capital requirements, the SCR and MICR. The tests were based on the deterministic and stochastic methods used to set capital requirements. Before these different methods can be used, however, a generic insurer model is required. This is required to calculate the two capital requirements and test their adequacy. The capital modelling principles discussed in this chapter provided the basis of the model building process.

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CHAPTER 8
THE MODEL MICROINSURER

8.1 INTRODUCTION

This chapter will describe the details of the generic model built for the comparison of the capital values of the SCR and MICR. This chapter is divided as follows. Section 8.2 will give a brief overview of the model. Section 8.3 will describe the workings of the model in detail. Section, 8.4 will describe how the assumptions used in the model were derived. Next the results of a sensitivity test performed on the model assumptions is shown in Section 8.5. Finally, a comparison between the finances of the model insurer and that of an actual South African microinsurer is provided in Section 8.6.

The scope of this thesis was limited to the capital requirements of a funeral insurer since this was the most prevalent microinsurance in South Africa.

8.2 OVERVIEW OF THE MODEL

The objective of the model was to project the income and balance sheet of a microinsurer. This could then be used for comparing the capital requirements and testing their adequacy.

The model was built by specifying a 'standard' microinsurer. The standard microinsurer was defined in this thesis as a funeral insurer with assumptions based on the average of industry data and a variety of other sources. The sources used are discussed in the assumption section (Section 8.4). The different income and outgo components were determined based on these assumptions which in turn were used to project the assets and liabilities. Figure 8.1 and Figure 8.2 provides an illustration of the financial workings of the model microinsurer with a more detailed description of the model being provided in the next section.

Statements in the first model year (or the base year, 2016) were calibrated based on the inputs provided in the model. The financial statements in the future years are then projected forward from the base year results.

To determine the financial statements in each projected year, the number of lives assured is required in those years. This is done by modelling the changes in the number of lives assured on a monthly basis starting with the assumed number of lives in the base year. The cashflows associated with each life assured (premium income, claim payments and acquisition expenses) was then calculated for each month and then aggregated over the year. The cashflows not attributed to any particular policyholder (operating expenses, investment income, dividends payments and tax) were calculated at the end of the year. These cashflows could then be used

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to determine the income statement. The cashflows from the income statement, applied to the closing balances of the previous year's balance sheet was then used to determine the current year's balance sheet.

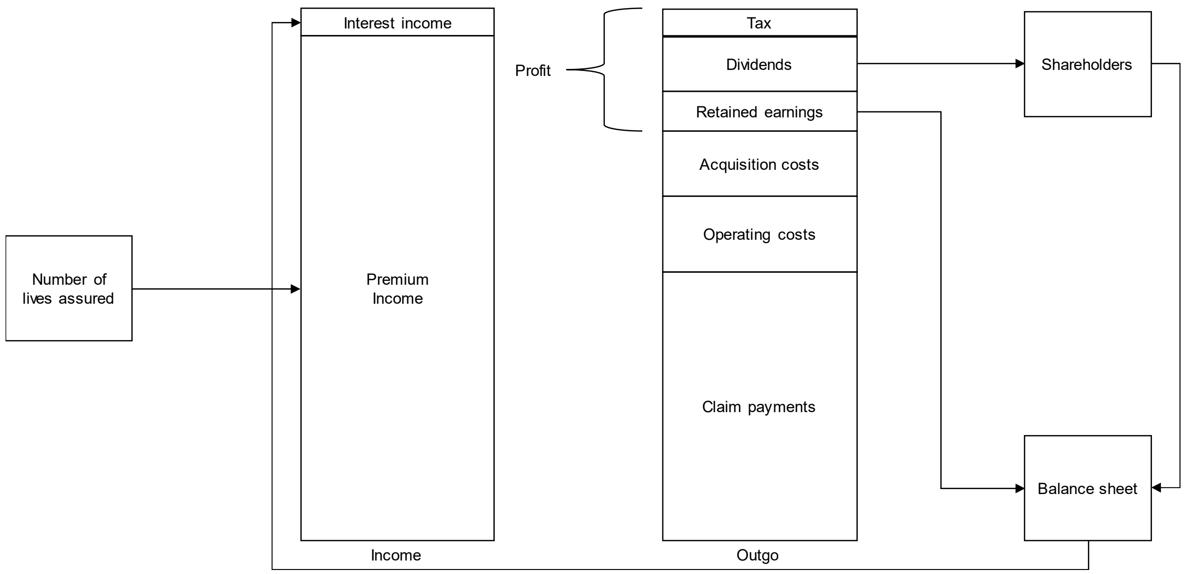

Figure 8.1: Income statement

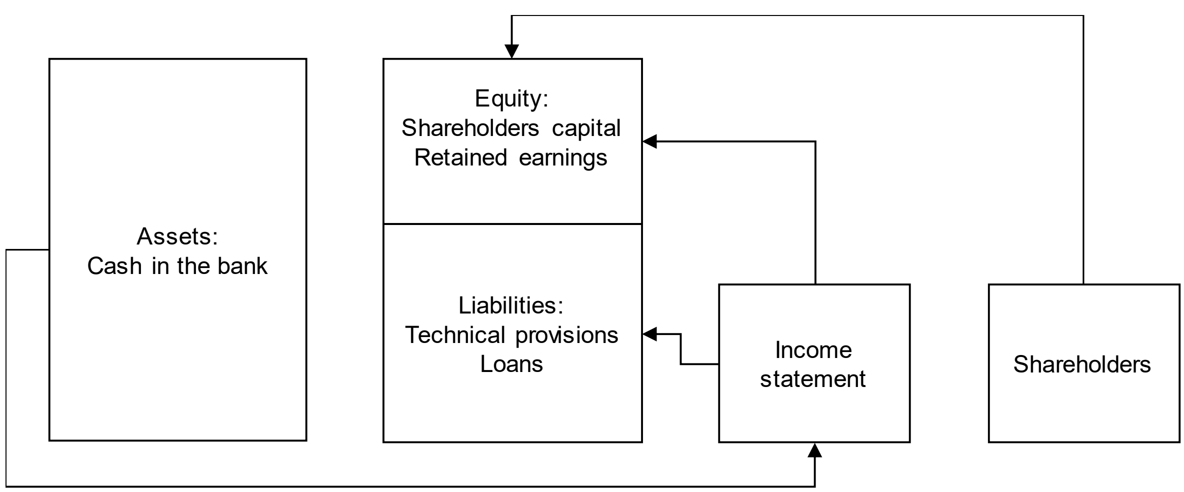

Figure 8.2: Balance sheet

Capital requirements were then calculated using the financial statements. The regulatory capital that needs to be held over any given financial year depends on the financial results at the end of the previous financial year*. For example, the capital requirements for the 2018 financial year will

* Some of the SAM risk modules are based on projected cashflows and would need to make use of projected financial statements, but this was not the case for the risk modules applicable to a funeral insurer.

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depend on the financial statements of the 31 December 2017 (the year-end for the model microinsurer).

Finally, as noted previously, a funeral insurer in South Africa is able to choose between the SAM SCR and the MICR if it qualifies for the microinsurance licence. The model calculates both of these capital requirements.

8.3 WORKINGS OF THE MODEL

8.3.1 Modelling horizon

The modelling period starts 1 January 2016. The number of lives assured, the average sum assured and the mix of policyholders by age at this starting point is specified as a model input. The number of lives assured and average sum assured is then projected on a monthly basis up until 31 December 2016 based on the model workings described in the rest of Section 8.3 and the industry calibrated assumptions described in Section 8.4. The 2016 financial year was set as the base year of the model. The assumptions are not changed when the comparisons and adequacy tests are performed in the remainder of the modelling horizon.

The next year in the modelling horizon, 2017, is used to assess the impact on the regulatory capital requirement of a change in the insurer's risk profile over this year. This assessment was done by comparing the capital requirements as at 31 December 2017 with different assumptions over the year (this assessment is discussed in detail in Chapter 9).

The deterministic and stochastic capital adequacy tests are performed in the next year, 2018, of the modelling horizon. The required capital for these tests were calculated at 31 December 2017. The tests are then performed on the projected experience over 2018.

8.3.2 Lives assured

To determine the different cashflows for each period, the number of lives assured had to be determined in each month. To do this, the lives assured were divided into eight age groups with the lives in each band being modelled separately. The number of lives in each age group in the first month of the first year was determined in the model by dividing the input number of lives assured based on the assumed mix of business. (The assumed mix of business is shown in Section 8.4.1 which also provides the details on how the numbers were derived).

The number of lives in the second month, and each subsequent month, was then determined based on the three movement assumptions.

The first movement assumption was the lapse rate. This is the proportion of the lives at the start of the period that lapse during that month. This lapse rate was assumed to be the same for each age group. The method used to derive the lapse rates is discussed in Section 8.4.6.

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The second movement assumption was the new business rate. This is defined as the number of new lives that take out funeral insurance from the insurer over the period as a proportion of the number of lives assured at the start of the period. The rate was applied to the total number of lives at the start of the period across all age groups. Lives are then allocated to each age group in the model based on the mix of business assumption. The actual new business rate used in the model is discussed in Section 8.4.6

The third movement assumption was the number of claims in each age group. This was based on the expected mortality experience in each age group. It was assumed that the age of the lives assured was uniformly distributed in each group. Thus, the average mortality rate for the age group was used to determine the number of claims. The mortality rate used is discussed in Section 8.4.4.

The number of lives assured in the second month for each age group was then calculated as follows. First the number of new lives assured allocated to that age group are added to the number of lives assured at the start of the month. Next, both the number of lapses and deaths from that age group are subtracted. This is then repeated to determine the number of lives in the third month, fourth month and so on.

8.3.3 Income statement

8.3.3.1 Premium income and claim outgo

The premium income for each age group in any month was then calculated as the number of lives assured for that month multiplied by the premium rate for that age group. The total premium income received in a financial year is then naturally the sum of the premium income in each month.

It was also assumed that the premium income was received uniformly over the month and was thus on average received half way through the month. This meant that the calculation above would produce written premiums. However, the income statement of an insurer should record earned premiums as opposed to written premiums. To adjust to earned premiums, the UPR at the start of the year is added and the UPR at the end of the year is deducted from the written premiums. (The UPR calculation is described in Section 8.3.4.)

The claims outgo in each month could then be determined by multiplying the claims in the month by the sum assured. The sum assured was assumed to be the same for each life. No adjustment had to be made to the claims outgo for any claims not yet paid at the end of the year since the claims were based on the number of deaths assumed to have occurred in the month. The calculation in the model thus provided incurred claims as opposed to paid claims.

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An adjustment was, however, required for lives that were in the waiting period. The waiting period is an initial period* after a life has taken out a policy in which claims are only paid out on accidental death. Thus, because the assumed mortality rate would include both accidental and non-accidental deaths, all non-accidental deaths in the waiting period had to be deducted from the total number of deaths in each month. The number of deaths in the waiting period in each month was approximated by adding up the new business over the previous six months, allowing for lapse up to that point. The mortality rate is then used to calculate the number of waiting period deaths. This is done for each age group with the total number of waiting period deaths being the sum of each group's deaths. The number of accidental deaths is approximately 10% of all deaths (Statistics South Africa, 2017: 22). Assuming this applies to the number of waiting period deaths, then the number of non-accidental waiting period deaths that needs to be deducted from the total number of deaths is 90% of the waiting period deaths. This then provides the number of valid claims for the insurer.

The claims outgo was then subtracted from the earned premium income to determine the gross profit of the insurer.

8.3.3.2 Insurer expenses

The insurer's expenses in the model were divided into acquisition cost and operating expenses. This was the same division used by the regulator to classify expenses. Acquisition cost is the cost of acquiring new policyholders. These can be divided into the internal cost of the insurer such as marketing, processing new policies and sales staff costs and the external costs paid to sales intermediaries, generally referred to as commission. Operating expenses are the cost of managing the company, providing administration services to policyholders, developing products, maintaining office space and other staff and computer costs. This represents the general costs of operating an insurer.

8.3.3.3 Acquisition cost

The acquisition cost was split between a fixed monetary amount per new life assured, to cover the insurer's administrative costs of acquisition, and a commission portion, which was a fixed percentage of the premiums paid for each life assured. The sum of the two portions was assumed to be 25% of premium income based on industry data (see Section 8.4.5).

The model calculated the commission paid in each month as 20% (Zondagh & du Toit) of the premium income received. This percentage was chosen based on discussions with industry experts. The fixed monetary cost per new life assured was calibrated at the outset of the model such that it was equal to 5% of all premium income received in the base year. This was done by

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* It was assumed that this period was equal to six months in the model.

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determining the total monetary amount of the 5% of premium income in the base year and dividing it by the number of new lives assured in that year. This amount, increased with inflation, was then multiplied with the number of new lives assured in each subsequent year to determine the total acquisition cost for that year.

The rationale behind the fixed monetary acquisition cost (the non-commission portion) per new life assured is to reflect the additional expenses an insurer would experience if it sold many more policies. This would not be reflected in the commission cost alone as this was based on premium from both existing and new business.

8.3.3.4 Operating expenses

The operating expense structure was designed to depend on the premium income, but still be partly fixed in nature. The rationale behind this approach was that simply applying the expense ratio to the year's premium income would not capture the risk of not writing sufficient business to cover fixed expenses. This is because the premium income and operating expenses would decrease in the same proportions. The process described below was a pragmatic approach to modelling a feature of a real-life insurance company.

The fixed element at the end of the base year was derived as a proportion – described in Section 8.4.5.1 – of the base year's premium income. This monetary amount is then adjusted over the projection period using the following rules:

- If the increase in lives assured was between 0 and 10% then it was assumed that the monetary amount would increase by inflation plus the percentage increase in lives assured. This was based on the assumption that the current systems would be able to handle the increase (i.e. the insurer has spare capacity of roughly 10%).
- If the number of lives assured decreased from the previous year then no increase was applied. It was assumed that some cost saving would be possible, hence no inflationary increase is necessary, but that any further cuts would not be possible, or management may decide against it if they believe business growth would resume in the following year.
- If the number of live assured increased in excess of 10% then the expenses were assumed to increase by inflation, the increase in the number of lives assured and an arbitrary 5%. The rationale behind this was that such a large jump would necessitate expansions of the systems, number of staff, etc.

8.3.3.5 Investment income

The investment income component arises from the interest earned on the assets held as cash in bank accounts. (The rate of return was assumed to be 7% - see Section 8.4.10.) The interest income was approximated as the interest rate multiplied by the assets at start of the year plus

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half a year's interest earned on the net cashflows (premiums minus claims and expenses). This assumed that these cashflows occur approximately half way through the year and that dividends and tax payments occur at the end of the financial year.

The actual investment income would depend on the cashflows over the year, but the added complexity of accounting for this was unlikely to result in material differences to the net profit due to it being only a small portion of the total income earned.

8.3.3.6 Net profit

The net profit before tax was calculated by subtracting the acquisition cost and operating expenses from the gross profit and then adding the investment income. The tax was then deducted (which is only applicable if the net profit was positive) to determine the net profit after tax. If this was positive, then dividends were deducted from this amount to determine the retained earnings.

8.3.4 Balance sheet

The resulting cashflows form the income statement, combined with the number of lives assured, could then be used to determine the balance sheet.

8.3.4.1 Liabilities

The liabilities of the insurer in each year was simply the value of the technical provisions in the respective year. The microinsurance regulation prescribes how the technical provisions must be calculated (see Section 5.5.1). The model still required assumptions with regards to UPR, OCR and URP. It was assumed that policyholders pay their premiums on average half way through the month and that the risk was uniformly spread over the month. Thus, the UPR was half a month's premium income. For the OCR, it was assumed that about half a month's claim payments were outstanding and thus it was set to half a month's expected claim outgo. The URP was set to zero as the UPR was deemed adequate to cover the future cost of claims and expenses.

SAM requires the technical provisions to be calculated on a market-consistent, best-estimate basis with a risk margin. However, the technical provisions for SAM were set to those calculated under the proposed microinsurance regulation. This was done for consistency as the primary objective of the thesis was to compare the capital requirements of the insurer which may be distorted if different provisions are used. The PA (2018e) does suggest that the technical provisions calculated under the microinsurance guidance notes are market consistent and thus should not differ materially from those that would be calculated under SAM.

8.3.4.2 Assets

The value of the assets in the base year was calculated by multiplying the liabilities with an assumed solvency margin ratio based on market data. The assets in each projected year were

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determined by adding the retained earnings and the change in the technical provisions to the assets of the previous year. The change in technical provisions needs to be added back because the assets will depend on the actual premium income received and the claims paid in the period as opposed to the premium income earned and claims incurred during the period as is shown in the income statement. Thus, to convert back to premiums written and claims paid, the change in the technical provisions simply needs to be added back to the asset value.

It was assumed that all the assets were in the form of cash held in banks, namely the five largest banks in South Africa.

8.3.4.3 Equity

The equity in the base year was determined as the difference between the assets and the liabilities. The equity in the projected years was calculated by adding the retained earnings to the previous year's equity value. No allowance was made for additional shareholder capital as the purpose of this thesis was to see if the current capital held, provided it met the regulatory requirements, was sufficient to cover losses under the varied stresses. Additional shareholder capital would thus distort these results.

8.3.5 Capital requirements

The microinsurance capital requirement was straightforward to calculate. The method used was discussed in Section 5.5.2. In 2016, it was assumed that the premium income was higher than that of the year before as the insurer was assumed to be growing prior to the modelling period. The capital requirement for 2017 was thus simply 15% of the written premium income of 2016. The capital requirement in subsequent years was 15% of either the previous year's written premium income or the year before that, whichever was larger. This was calculated for both with and without the capital floor in the model.

The SAM requirement was significantly more complex with the required formulae and methods described in Chapter 4. The remainder of this section will describe how the components in the model were calculated using these formulae and methods. The different components were combined based on (4.1), (4.2) and (4.3).

8.3.5.1 Life underwriting risk

The mortality risk requirement was calculated using (4.4). The modified duration n was set as the minimum of one since the funeral insurance contract boundary was less than 12 months. The weighted average mortality rate, q, was determined by taking the weighted average of the assumed mortality rates in each age band where the weights were based on the mix of business by age group. This was equivalent to taking the weighted average based on the sum assured since the sum assured was the same for each life.

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The lapse risk capital requirement was initially expected to have a non-zero value and was calculated by applying the mass lapse scenario in Section 4.5.4.3. However, the regulation allows an insurer to approximate a contract boundary of less than three months to zero. This approximation was used in this thesis after a discussion with Kühnast (2017) and Zondagh and du Toit (2017). Therefore, the value of this risk module was set equal to zero.

The expense risk capital requirement was calculated using (4.6). The interest rate used is discussed in Section 8.4.10.

The life catastrophe risk requirement was calculated by applying (4.7) to the mortality rates for each age group. The results were then applied to (4.8) with the minimum contract boundary of two months assumed. Technically, the insurer can change the contract terms within a month and thus the one-month contract boundary should apply. However, in practice, changing the contract terms during a catastrophe is likely to take longer than a month and thus a two-month contract boundary was assumed for this calculation.

8.3.5.2 Market risk

The spread and default risk requirement was calculated using (4.9). It was assumed all five of the banks in which the insurer held cash had CQS of ten (corresponds roughly to the credit ratings of the five major South African banks). This meant that a factor of 2.56% was used. The concentration risk was calculated using (4.11) with XS_i calculated assuming that the insurer held an equal amount of cash at each bank and g_i set to 0.45.

8.3.5.3 Operational risk

The operational risk requirement was calculated using (4.12). Op was set to $Op_{premiums}$ as this was greater than $Op_{provisions}$. Op was also greater than 30% of the $BSCR$.

8.3.6 Management action

It is possible for an insurer to assume that future losses may be mitigated when calculating the SAM SCR. This allows the insurer to lower its calculated SCR subject to certain limits. Any management action would, however, be very specific to an insurer and would thus be very difficult to include in the model in a meaningful way. Therefore, no allowance has been made for management action.

8.4 ASSUMPTIONS

This section will outline how the various assumptions were derived.

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8.4.1 Business mix

The business mix assumption was determined using the 2016 All Media and Product Survey (AMPS). The survey interviews people at their homes with a wide variety of questions asked, including the use of financial products (South African Audience Research Foundation, 2012). AMPS was used to determine the distribution of policyholders amongst the different age groups.

The survey data was extracted from the Eighty20 (2017) database. The survey showed the number of adult South Africans who had funeral insurance from a formal financial institution and the number of adults who belonged to a burial society per age group. The distribution assumption in the model was based on the distribution by formal financial institutions as the model microinsurer was a regulated insurer. The business mix for the model microinsurer is shown in Table 8.1.

Table 8.1: Distribution of lives by age group

Age groups		**Percentage of total in the age group**	
Lower bound	**Upper bound**	**Financial institution**	**Burial Society**
18	19	2%	4%
20	24	4%	7%
25	34	24%	20%
35	44	24%	20%
45	49	12%	9%
50	54	9%	9%
55	64	13%	18%
65	85	12%	13%

Source: Eighty20, 2017

The age groups from the AMPS survey differ slightly from that shown in the table. The first band in the AMPS survey is from 15 to 19 whereas that in the model was from 18 to 19. It was assumed that no one under the age of 18 (the legal age to purchase insurance) had funeral insurance. Thus, this AMPS band was narrowed to only include 18 and 19 year olds. This discrepancy was likely due to adults being defined in the survey as anyone over the age of 15 (South African Audience Research Foundation, 2012).

The upper band of the AMPS survey was also defined as 65 and above. In the model, the age band was narrowed to include people between the ages 65 and 85 only. This was due to most funeral insurance products having a maximum age of 85.

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8.4.2 Premium rates

The age groups used in pricing the policies were based on two broad age groups. These were from 18 to 55 and 56 to 85. This was in line with market practice (based on the pricing websites of various South African Insurers). The premium rates used in the model were based on the True South Quote Engine. The quote engine generates a premium rate per R1 000 sum assured for the selected age bands for a single member policy, a member and spouse policy, a family policy and a member and children policy. The model determines the pure risk premium based on the ASSA2008 projected mortality rates plus a user specified adjustment for anti-selection. The total premium is determined by adding loading factors for administration costs, commission and profit. These loadings are specified by the user.

The premium rates used in the model were calculated with the loadings specified after a discussion with True South*. The premium rates are shown in Table 8.2. The rationale behind using the premium rates generated in this way was that many of the type of insurers that the simplified microinsurance regulation would appeal to would likely have limited experience in the technical aspects of an insurance company including the pricing of the insurance policies. They would thus likely outsource some of the work to be performed until they have built up sufficient in-house expertise.

Table 8.2: Model premium rates

	Age bands	Single member (R)	Member and spouse (R)	Member and children (R)	Family (R)
Risk premium	18-55	1.10	2.20	1.35	2.45
	56-85	3.80	7.60	4.01	7.81
Administration Loading (20%)	18-56	0.44	0.88	0.54	0.98
	56-85	1.52	3.04	1.60	3.12
Commission Loading (20%)	18-55	0.22	0.88	0.54	0.98
	56-85	1.52	3.04	1.60	3.12
Profit loading (10%)	18-55	0.22	0.44	0.70	0.49
	56-85	0.76	1.52	0.80	1.56
Total premium	18-55	2.20	4.40	2.70	4.90
	56-65	7.60	15.20	8.02	15.62

8.4.3 Sum assured

To determine the premium income for the model insurer, a sum assured was needed. The average sum assured of a funeral insurance policy according to a Cenfri survey was R8 500 in

* The discussion, loadings specified and premium rates derived are intended for academic purposes only.

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2012. It was assumed that the sum assured increased at the rate of inflation, roughly 6%, until the base year resulting in an average sum assured of approximately R10 000.

It was assumed that this average sum assured in the base year would continue to increase at the rate of inflation for each of the projected years.

8.4.4 Mortality rates

The mortality rates used to determine the number of claims for the funeral insurer were those produced by the Thembisa demographic model (Johnson, Chiu, Myer, Davies, Dorrington, Bekker, Boulle & Meyer-Rath, 2016). The latest version of the model was released in 2017. The model projects a number of demographic statistics with the one of interest for this thesis being the mortality rates for the South African population for each age.

8.4.4.1 Thembisa rates

The mortality rates from the Thembisa model are initial annual rates for the year starting in June. The policyholders are grouped into eight age brackets based on the business mix data (see next section). It was assumed that the age of policyholders in each group was uniformly distributed. Thus, the average mortality rate of the age bracket was used as the claim rate for the particular age group (see Appendix A.2 for the rates used). The mortality rate per age would have given more accurate expected claim amounts, but given the narrowness of the age bands, this was not expected to have a significant impact on the results.

8.4.4.2 ASSA2008 rates

An alternative model that was also looked at was the ASSA2008 model which is a similar demographic model released in 2011 and includes all deaths reported in South Africa up to 2008 (Fild, 2011: 1). The Thembisa model shares some traits with the ASSA2008 model but includes several improvements and is based on more recent data.

A comparison was performed between the mortality rates from the ASS2008 and Thembisa models relative to recent mortality data. This comparison is shown in Figure 8.3 where the percentage difference in the mortality rates projected for 2015 under the two models relative to the mortality rates derived from the 2015 General Household Survey (GHS) is shown. For example, a value of 0% would indicate that the mortality rates of the GHS and the Thembisa model are exactly the same.

The figure shows how the mortality rates from the Thembisa model are a more accurate reflection of the more recent mortality data than the ASSA2008. The Thembisa model is very close to the GHS rates for the ages of 20 to 75. Both models underestimate the death rate above age 80 since they only include mortality rates up to the age of 90 whereas the general household survey will include deaths above this age. The reason for the differences in the ages below 20 is unclear but

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should not have a major impact on the model since all lives assured in the model were at least 18 years old.

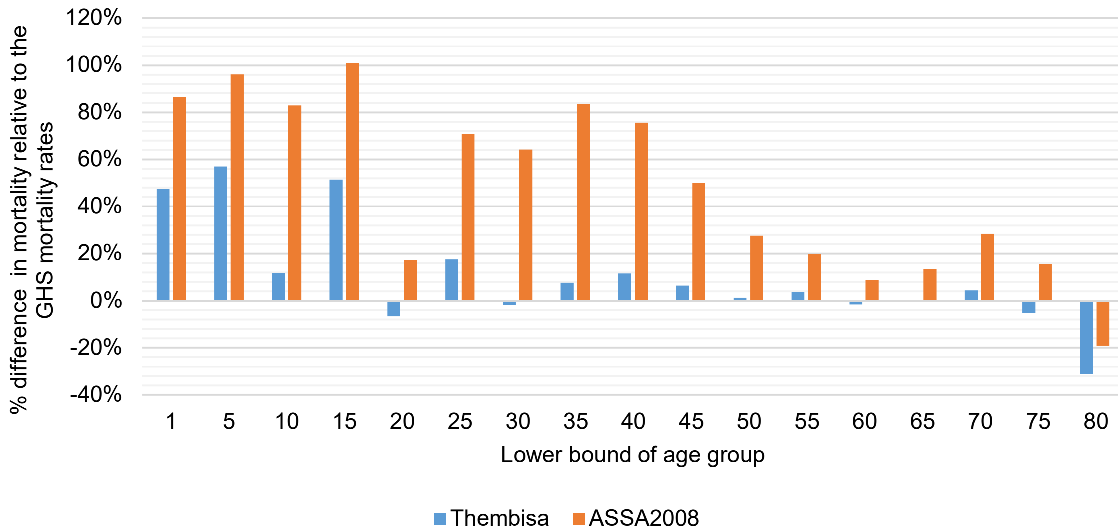

Figure 8.3: Thembisa vs ASSA2008 mortality rates

Source: Dorrington, Johnson & Budlender, 2010; Johnson *et al.*, 2016; Statistics South Africa, 2017: 78

8.4.4.3 Mortality rate loading

Using the chosen premium and mortality rates did however result in the insurer having a claims ratio of less than that derived from market data. Market data (the next section describes where this data was sourced from) indicated that the average claims ratio – the cost of claims divided by the premium income – of microinsurance business in South Africa was approximately 43%.

A possible reason for this could be due to anti-selection. However, it has been shown in past investigations that the mortality experience of the main life has been better than that of the population as a whole (Continuous Statistical Investigations Committee, 2007: 7). The differences may thus be due to anti-selection of other lives that may be covered under the policy. The reason for the differences in the market claim ratios and those derived using the Thembisa mortality rate and True South Quote Engine was not clear.

However, it was decided that the model should both be consistent with the market data and still use the market related premium rates from the quote engine. Thus, it was decided to apply a loading to the mortality rates so that the claim ratio in the base year for our microinsurer was roughly in line with that seen in industry. The loading of 38%, which was derived in the base year, was applied to each year in the modelling horizon.

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8.4.5 Insurer expenses

The expenses of the insurer were linked to the premium income. This was achieved through using ratios of operating expenses to premium income and acquisition costs to premium income. The ratios were determined using the Long-Term Insurance Registrar's reports about the long-term insurance industry of South Africa. The Registrar is an appointed member of the FSB executive and all long-term insurers are required to register and report their results to the registrar for inspection (National Treasury, 1998: 16–18). The reports were based on these reported results.

The Registrar's reports provides tables of the financial results for 72 registered primary long-term insurers and 7 registered reinsurers (Insurance Division, 2017b: 2). It includes details about the insurer's income, outgo, policyholder movements, assets and liabilities. The data from the reports between 2012 and 2016 were used. Data prior to 2012 was deemed less relevant for this report and was thus not included and data after 2016 was not available at the time of writing.

Table 8.3: List of insurers whose premium income consisted of at least 70%* assistance business for at least one of the years from 2012 to 2016

Insurer	2012	2013	2014	2015	2016
Bophelo Life				100%	78%
Constantia Life and Health	92%	89%	86%		
Constantia Life Limited	100%	100%	100%	100%	100%
Covision Life	89%		79%		
KGA Life	100%	100%	100%	100%	100%
Lion Life			79%	89%	36%
Nest Life	71%				
Safrican	79%				
Smart Life			72%		89%
Union Life	100%	99%	98%	97%	97%

Source: Insurance Division, 2013, 2014, 2015, 2016, 2017b

The insurers in the report wrote a wide variety of business and thus it was not suitable to use the results from all of them to determine the average ratios and amounts for the funeral insurance industry. The list of insurers was hence narrowed down to those that reported to write predominately funeral insurance business. This was done with the help of the different insurance business categorisation used in the report, namely: typical, niche, cell captive, linked investment, reinsurance and assistance. It is the last of these categories, assistance business, which is

* The grey entries indicate the year that the particular insurers data was not used in calculating the ratio due to it assistance business premiums making up less than 70% of the insurer's premium income.

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defined as insurance business where the sum assured is less than R30 000 (Insurance Division, 2017: 21), that was used to determine which companies wrote mostly assistance business.

Approximately 30 of the registered insurers wrote some assistance business in 2016 (Insurance Division, 2017b: 3). The number of insurers who wrote assistance business and the amount they wrote changed over time. It was decided to only use the expense and premium information used from insurers whose assistance business made up at least 70% of their premium income. The different insurers included and the years they were included is shown in Table 8.3.

8.4.5.1 Expense ratios

The operating and acquisition cost ratios were determined by dividing the respective expense amount by the gross premium income. Gross premium income was used since the model did not allow for any reinsurance.

These ratios were determined for each of the insurers for each year from 2012 to 2016 provided they were included for that year. The weighted averages of the ratios were calculated for each year and are shown in Table 8.4. The weights were based on the total premiums written by the insurer in the relevant year. The ratio used in the model were rounded to the nearest 5% due to the ratios only being a sample and using the unrounded amount would potentially be spurious. Based on this, the operating expense ratio and acquisition cost ratio used in the model were 25% each.

The ratio for each individual insurer in each year is also provided in Appendix A.3.

Table 8.4: Historic operating and acquisition cost ratio for predominately-assistance insurers

Year	Operating cost ratio	Acquisition cost ratio
2012	14%	23%
2013	14%	32%
2014	38%	22%
2015	33%	28%
2016	28%	27%
Average	25%	26%

Source: Insurance Division, 2013, 2014, 2015, 2016, 2017b

8.4.6 Policyholder movement assumptions

The policyholder movements required for the model were the number that lapsed, the number of new policyholders and the number of deaths (the number of deaths was covered in Section 8.4.4).

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A single annual lapse rate assumption was derived from durational-based lapse rates used by AVBOB Mutual Assurance Society (2016: 22) in their financial statements. These were 36.5% of lives assured in the first year, 18.5% of lives assured who still have policies in the second year, 12% in the third year and 7.5% for each year thereafter.

The single annual lapse rate in any given point in time would thus be dependent on the durational profile of policies at that point in time. A simple model was therefore constructed for a notional insurer, starting with sales of, say, a 100 new policies in the first year. This first tranche of new business is then assumed to experience the lapse rates as specified above over time. In each subsequent year, an additional tranche of new business is added to the model, where the new business sales are assumed to be 5% higher compared to the previous year (for example, in the second year 105 are assumed to have been sold). This growth rate is roughly based on the growth in the South African financial sector over the period 2013 to 2017 (SARB, 2018) and is referred to as the new business growth rate in this model. The durational lapse rates are then applied to each new tranche.

Table 8.5: Duration based lapse rates transformed into annual rates

Year of operation	New business rate	Lapse rate
1	100%	37%
2	62%	30%
3	48%	26%
4	41%	23%
5	36%	21%
6	32%	20%
7	30%	19%
8	28%	18%
9	26%	17%
10	25%	17%
11	24%	17%
12	23%	16%

At each particular point in time, it is possible to derive new business sold in that year, as proportion of in-force business in that year. This is referred to as the new business rate[*] in this thesis. The average lapse rate is derived as the sum of lapses from each tranche of business divided by the in-force business in that year. Table 8.5 shows the development of these rates over time. More

[*] Note that this differs to the new business growth rate which is the proportion of new business sold in the current year relative to the new business written in the previous year.

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details of the method used to calculate the movement rates and an illustrative example is shown in Appendix A.4.

To check the reasonability of the rates, the lapse rate and new business rate were also calculated from the Long-Term Insurance Registrar's reports. This was done using the lapse and new business movement numbers from the selected companies in the reports. The rates were calculated using the same approach as in Section 8.4.5.1 resulting in a lapse rate of 23% and a new business rate of 36%[*].

This would seem to indicate that the average book of assistance business held by an insurer was about five years old, although this is dependent on several assumptions. It was also assumed that the model insurer was five years old at the start of 2016. Hence, the lapse rate and new business rate used in this year were the values corresponding with year five in the table. The values used in 2017 corresponded with year six and so on.

8.4.7 Type of policyholders

The final insurer specific assumption required to project the balance sheet was the number of policyholders in-force at the start of the base year. An issue with this assumption was that the number of lives per policy will differ depending on the type of policies. Funeral insurance policies come in many forms with the main groupings being single member, member and spouse, member and children, and family. The number of lives assured per policy will thus vary per policy.

This complication was dealt with in the model by assuming that the lives assured were independent and that the input assumption was the number of lives rather than the number of policyholders. It was likely that there would be some correlation between the mortality rates of lives under the same policy, but the correlation was assumed to be immaterial.

The type of policyholders could also affect the expense and movement assumptions. Selling a single policy covering two lives is likely to be cheaper than selling two separate policies, but only just as the commission would still be a proportion of the premium with the other acquisition costs being slightly less. The model in this thesis may possibly overstate expenses slightly.

For the lapse rate assumption, the lapse of a single policy would possibly lead to the lapse of a different number of lives depending on the type of policy lapsed. However, for the model used in this thesis, lapses were modelled per life assured as opposed to per policy. The same applied to the new business and claim rate assumptions.

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[*] Note that that this calculation did not allow for the movement of groups of policies as the FSB reports did not specify the size of the groups for the insurers.

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The approach discussed was a pragmatic way of dealing with multiple types of policies as allowing for multiple policy types was unlikely to provide much more insight than modelling lives assured.

8.4.8 Number of lives assured

The number of policyholders from the Long-Term Insurance Registrar report varied from less than ten thousand assured to over seven hundred thousand. To determine the number of lives assured for the model microinsurer, the number of lives was chosen such that it is fairly consistent with the insurer's that wrote nearly a 100% assistance business (this is shown in Table 8.6). It should however be noted that all of these insurers, besides KGA, also insured group policies and thus were likely to be larger than the numbers shown in the table.

Table 8.6: Number of lives assured as at the end of 2016 for insurers writing approximately 100% assistance business

Insurer	Number of lives assured
KGA	390 000
Union Life	235 000
Worker's Life	170 000
Constantia Life	30 000

Source: Insurance Division, 2017b

Another aspect considered when setting the number of lives assured was to ensure that the capital requirement exceeded the absolute minimum of R4 million for the proposed microinsurance regulation and R15 million for the SAM regulation. An assumption of 300 000 lives assured was deemed appropriate in light of this requirement and the numbers shown in the table.

8.4.9 Financial assumptions

Several financial assumptions were also required to project the balance sheet. Firstly, an assumption for the initial solvency margin ratio was required (i.e. the assets as a proportion of the liabilities). Secondly, a tax rate was required which was assumed to be the standard corporate tax rate in South Africa. It was 28% at the time of writing. Finally, a dividends payout ratio (i.e. the proportion of the profit after tax paid out as dividends) was required to determine the retained earnings.

8.4.9.1 Solvency margin ratio

A solvency margin was required to determine the initial value of the assets of the insurer. To determine an appropriate ratio, the ratio of the asset to liabilities of the insurers from Table 8.3 was calculated using the same approach as in Section 8.4.5.1. This resulted in a ratio of 2.8.

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However, it was required that the ratio would result in the free assets of the microinsurer exceeding the SCR and MICR. The ratio was thus adjusted upwards to 3.5.

8.4.9.2 Dividends payout ratio

The dividends payout ratio was assumed to be an arbitrary 70%. This ratio should have minimal impact on the results since the microinsurer would not pay out dividends if it were loss making – which was the case for most of the stressed tests used in this thesis.

8.4.10 Economic assumptions

The final set of assumptions required are the external assumptions which are not insurer specific. These were the interest and inflation rates. The interest rate earned on assets held (all of which was assumed to be cash in the bank) was assumed to be 7% per annum which was roughly the average interest rate for short term deposits according to data from Deposits.org (2017). The inflation rate was assumed to be 6% per annum. The South African inflation rate has varied over the past few years but has roughly averaged 6% (Statistics South Africa, 2018) This rate also represents the upper bound of the inflation target of the SARB.

8.5 PARAMETER SENSTIVITY CHECKS

Due to the uncertainty in setting some of the assumptions, sensitivity tests were performed. This helped to determine the significance of the assumptions where there was a large amount of uncertainty and also to give some indication of the reliability of the model.

To measure the sensitivity of the results to an assumption, the change in the microinsurer's profit margin was measured. This was done for the 2017 financial year. The base profit margin of the microinsurer was 7.5%.[*]

8.5.1 Business mix

The first sensitivity test was to see how the model results changed if the business mix from the burial society was used as opposed to that from financial institutions (see Table 8.1). The results were surprisingly sensitive to this. The profit margin increased to approximately 10%. This was mostly due to the mix of business under the burial society resulting in a lower average policyholder age. This would result in a lower claims experience overall whilst having a minimal impact on premium income due to the large pricing age bands.

Whilst the model was sensitive to this assumption, the chosen distribution did not seem unreasonable.

[*] This is lower than the 10% margin in the True South Quote Engine due to the additional mortality loading.

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8.5.2 Mortality loading

The next sensitivity test performed was on the mortality loading. As would be expected, the model results were sensitive to the chosen mortality loading. This means that the model may be understating the profit of the microinsurer if the loading chosen is too high. However, given that the loading is consistent with market data, it was deemed to be appropriate (the base loading is 38%).

Table 8.7: Change in profit margin for different mortality loadings

Loading	Profit margin
0%	19.5%
20%	13.2%
38%	7.5%
60%	0.6%
80%	-5.5%

8.5.3 New business growth rate

Sensitivity tests were also performed on the new business growth rate. It was found that the profit margin was not very sensitive to this as setting the rate to 0% produced a profit margin of 7.4% and doubling the rate to 10% produced a profit margin of 7.7%. (The base new business growth rate was 5%.)

8.5.4 Durational lapse rates

Next, the durational lapse rates were tested. The profit margin proved not to be very sensitive to decreases in these rates. The profit margin decreased to 7% when these rates were halved. It did however prove more sensitive to increases in these rates. Doubling them produces a profit margin of 10% (the reason why increasing the lapse rates by this magnitude increases the profit of the microinsurer is discussed in detail in Section 10.2.2.2). While this is significant, the chosen lapse rates did not seem unreasonable.

8.5.5 Waiting period

The sensitivity of the results to the waiting period was also investigated. The model proved surprisingly sensitive to this assumption. If the waiting period was decreased to 1 month then the profit margin would fall to 2% whereas it would increase to 13% if it was increased to 12 months. The reason for this is mostly due to the large amount of new business that the microinsurer adds in a year.

Whilst the results are sensitive to this outcome, the microinsurer is likely to revise their premium rates if they are offering more or less generous terms. Thus, it was assumed that a shorter waiting

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period would result in a higher premium rate and vice versa. Since the premium rates from the True South Quote Engine are based on a waiting period of six months, the current assumption was deemed appropriate.

8.5.6 Accidental death rate

The final sensitivity test was performed on the accidental death rate. The model proved to be much less sensitive to this assumption than the waiting period assumption.

8.6 INSURER'S BALANCE SHEET AND FINANCIALS

To provide an additional indication of the reasonability of the results, the final section of this chapter provides the financial statements of the model microinsurer for 2016 compared with the financial statements of KGA Life. KGA Life is a funeral insurer of a similar size as the model insurer (it had 390 000 lives assured as opposed to the 300 000 in the model). The income statement and balance sheet comparison are shown in Table 8.8 and Table 8.9 respectively. This showed that the finances of the model microinsurer did not differ significantly from KGA life. This is not too surprising as the model input assumptions were based on data that included KGA.

This did still provide some comfort that the chosen set of assumptions did produce a reasonable model output.

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Table 8.8: Income statement of the model microinsurer compared to KGA Life (R'000s)

	Model microinsurer as at 31 December 2016	KGA Life as at 30 September 2016
Earned premiums	133 856	168 552
Claims incurred	-57 535	-84 754
Gross profit	**76 321**	**83 798**
Operating expenses	-35 097	-34 468
Acquisition costs	-33 709	-45 622
Other	-	-1 164
Total	**-68 806**	**-81 254**
Investment income	2 844	2 951
Other income	-	3 609
Net profit	10 359	9 104
Tax	-2 900	-1 996
Profit after tax	**7 458**	**7 108**

Source: Insurance Division, 2017b

Table 8.9: Balance sheet of the model microinsurer compared to KGA Life (R'000s)

	Model microinsurer as at 31 December 2016	KGA Life as at 30 September 2016
Assets	**43 585**	**51 623**
Cash & Deposits	43 585	8 302
Fixed Interest	-	16 125
Equities & Convertible Debentures	-	14 270
Property	-	-
Collective Investment Schemes	-	-
Fixed Assets	-	3 609
Current Assets	-	6 794
Other Assets	-	2 523
Equity	**31 132**	**34 144**
Liabilities	**12 453**	**17 479**
Insurance liabilities	12 453	5 821
Other liabilities	-	11 658

Source: Insurance Division, 2017b

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Table 8.10: Selected accounting ratios of the model microinsurer compared to KGA Life

Ratios	Model microinsurer as at 31 December 2016	KGA Life as at 30 September 2016
Claim incurred / Earned premiums	43%	50%
Operating expense / Earned premiums	26%	20%
Acquisition expenses / Earned premiums	25%	27%
Investment income / Assets	7%	6%
Assets / liabilities	350%	295%

Source: Insurance Division, 2017b

8.7 SUMMARY

This chapter provided the details of the model microinsurer used to compare the SCR and MICR. The aim of the model design was to be a good representation of the microinsurance market of South Africa and to adhere to the capital modelling principles described in the previous chapter.

The most important assumptions for the model were the movement rates, the premium rates, claim rates and expenses. These assumptions drove the financial results of the model microinsurer. Whilst there was uncertainty surrounding some of the model assumptions, the financial results did appear to be reasonable when compared against a similar sized microinsurer in the South African market. The model was thus considered robust enough to provide a comparison between the two capital requirements as is shown in the next chapter.

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CHAPTER 9
COMPARISON OF SAM AND THE MICR

9.1 INTRODUCTION

This chapter will present a comparison of the capital requirement under SAM and MICR for the model insurer. This was done for the model microinsurer under the industry standard assumptions discussed in the previous chapter. The comparison was done based on the capital requirement calculated in the model as at 31 December 2017.

A capital requirement should ideally be appropriate for various different types of microinsurers. Thus, comparing the SAM SCR and the MICR for a single model microinsurer was unlikely to provide the full picture as different microinsurers in the industry are likely to have different risk profiles.

The appropriateness of the capital requirements with regards to this aspect was also tested. This was done as follows. For each scenario (discussed below), the model microinsurer's risk profile was assumed to change over the 2017 financial year. The risk profile of the insurer was changed by varying the model assumptions over 2017. The capital requirements were then recalculated at 31 December 2017 under the scenario. The changes in both the SAM SCR and MICR relative to the original values were then assessed to determine whether the change in the capital requirement was reasonable.

The change in the capital requirements were assessed by considering the nominal values relative to a risk measure. A risk measure was required as the change in the nominal values may be due to a change that does not impact the insurer's risk profile. For example, if the microinsurer had more lives assured under a certain scenario, but the risk per life assured remained constant, then the capital requirement per life assured would not be expected to change.

The risk measure used in this thesis was the sum-at-risk. This is defined as the amount the insurer will pay out if all policyholders were to claim at once. The advantage of this measure is that it allows for changes in number of lives assured and for changes in inflation (as the sum assured was assumed to increase with inflation over time).

The scenarios assessed were microinsurers:

- charging different premium rates;
- with different claims experience;
- with different lapse experience;
- growing at different rates; and
- of different sizes.

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Detailed analysis was provided for the first four scenarios. For each, details of how one would expect the capital requirements to change are discussed given the change in risk. The actual change that occurs is then provided with an explanation of why the requirement changed in the way that it did. The reasonability of the change is then discussed.

Detailed analysis of the last comparison was not provided as there was little additional insight derived from these comparisons. Details of the results of this comparison can however be found in Appendix B.1.1.

The assessment was also performed over a ten-year period to see if there were any differences in the results when a longer period was considered. This was done by seeing how the capital requirement changes in each year from 2017 up until 2026 if the changes in risk profile were assumed to continue in each of those years. It was found that the analysis did not change significantly when a longer time period was investigated.

9.2 COMPARISON OVER A ONE YEAR PERIOD

9.2.1 Model microinsurer

For the model microinsurer, the SAM capital requirement exceeded the MICR, but the two were fairly close in value. The SAM requirement was R26.6 million (0.67% of the sum-at-risk) and the MICR was R23.8 million (0.60% of the sum-at-risk) as at 31 December 2017 – a difference of approximately 10%. This difference was not that significant given the simplicity of the MICR. It would thus appear that the simplified approach for microinsurance is a good approximation of the SAM SCR.

A breakdown of the risk makeup – the proportion of the capital requirement attributed to each of the different risks – of the capital requirement is presented to highlight the main risk a microinsurer faces based on the capital requirements. It was not possible to determine the risk makeup of the MICR as this was a flat rate of 15% of premium income. Figure 9.1 shows the proportional split of the capital requirement between the risk modules of the SCR.

The figure shows that the life underwriting risk modules (mortality, expenses and catastrophe) were by far the largest, as would be expected for a funeral insurer. In particular, the mortality risk modules (Mortality and Catastrophe) are the largest making up nearly 60% of the SCR after allowing for diversification

The market risk modules were relatively small due to all assets being held in the bank account which meant that the stresses applied to the assets were not significant. The operational risk module also made up a fairly large proportion of the SCR.

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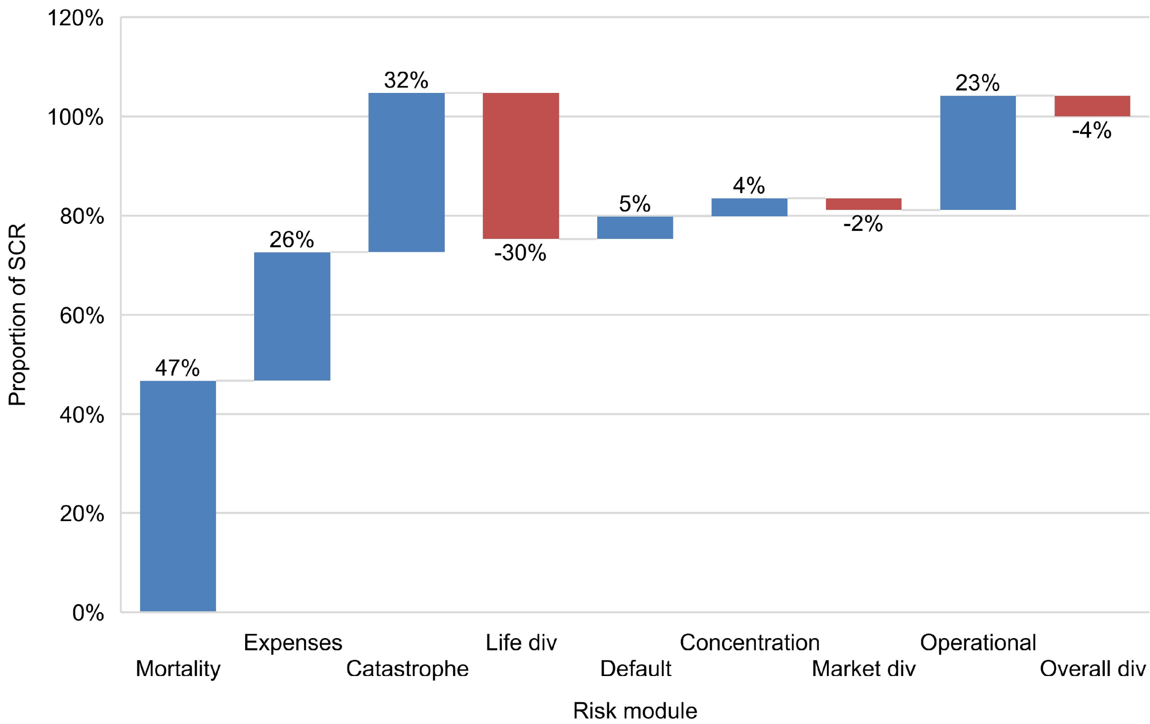

Figure 9.1: Contribution to the SCR from each risk module and the diversification (div) benefit

With the model microinsurer results determined, the next area of interest was changes in the risk profile of the microinsurer.

9.2.2 Microinsurers charging different premium rates

The first change in a microinsurer's risk profile considered was if the microinsurer charged a different premium rate in 2017 for the same risk. The aim of the comparison was to investigate the impact on the capital requirements of microinsurers operating in different competitive environments. For the comparison, it was assumed that the microinsurer premium income decreased in more competitive environments whilst claim payments remained unchanged and all other expenses (apart from commission, which is a proportion of premium income) also remained unchanged relative to the model microinsurer. For microinsurers in less competitive markets, it was assumed that the premium income would increase.

In an ideal world, if a microinsurer decreases its premium rates then one would want it to hold additional capital. This is due to the greater risk of not earning sufficient premium income to cover expenses and claims payable to policyholders. Thus, it would be preferred that the microinsurer hold additional capital in a highly competitive market to protect against the extra risk arising from

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a lower profit margin. Conversely, it would be expected that the capital requirement would decrease as the microinsurer charged higher premium rates.

This relationship between risk and premium rates will not always hold. A microinsurer may opt to charge higher premium rates in a competitive environment and sell fewer policies which increases the risk of it not selling a sufficient number of policies to cover fixed expenses. However, one would still want this relationship between capital requirement and premium rates to be true approximately.

This ideal relationship would not be the case for a microinsurer holding the MICR as this was directly proportional to the premium income and thus the premium rate charged. Figure 9.2 shows how the capital requirement at 31 December 2017, as a proportion of the sum-at-risk, changes for different changes to the premium rates charged over the year.

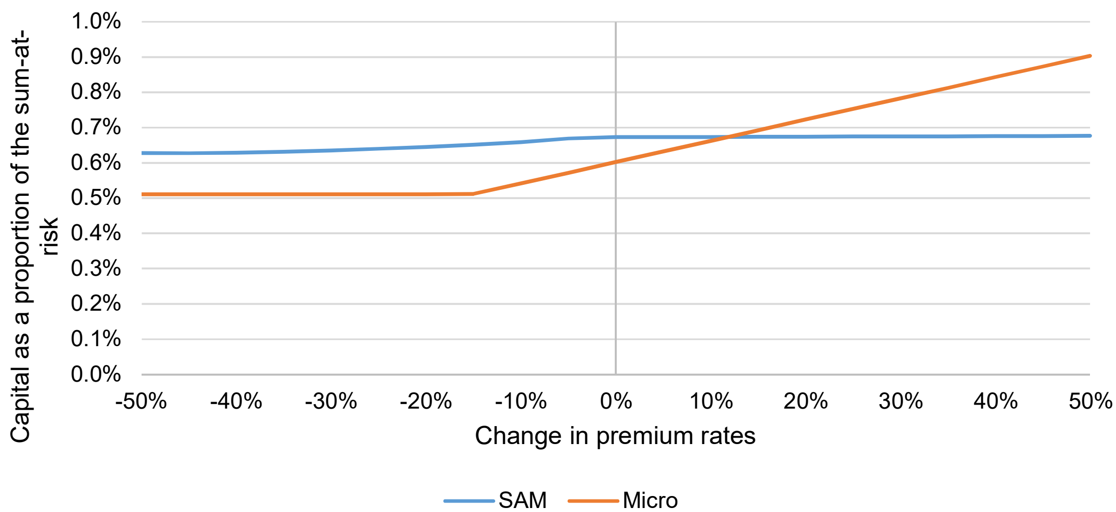

Figure 9.2: Impact of different premium rates on the capital requirement as a proportion of the sum-at-risk

As expected, the MICR moves in the opposite direction to the ideal with the capital requirement decreasing as the premium rates decrease. This result was likely to be the largest weakness of the MICR. It is a particular issue if the microinsurance products are not priced appropriately which is common amongst informal funeral insurers (CENFRI, 2013). There are likely to be two major reasons why a funeral insurer may want to exploit this weakness. Firstly, a funeral insurer may decrease its premium rates to release capital required for other purposes. Secondly, a funeral insurer may decrease the capital requirements to undercut its competitors and gain from the additional benefit of being able to write more business without needing to raise additional capital.

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To exploit this weakness would however take some foresight as the capital requirement is based on the premium income of the past twelve months or the twelve months prior to that, whichever was larger. Thus, an insurer would need to lower premiums for at least a year to benefit from this. This was the reason why the MICR levels out after a 15% decrease in the premium rates over the year. The capital requirement at this point depends on the premium income in 2016.

The relationship between the SCR and premium rates was not as clear cut as with the MICR. The operational risk component of the SCR depends on the premium income and thus also decreased as the premium rate decreases. The decrease was however not as pronounced since this module only made up about 20% of the SCR, after diversification. An increase in the premium rates also only increased the operational risk module up to a limit of 30% of BSCR which is why the SCR stays fairly constant when the premium rate is being increased. This was why the microinsurance capital requirement becomes larger than the SCR as the premium rate increases with the crossover point being reached after about a 10% increase in the premium rate.

9.2.3 Microinsurers with different mortality experience

The next change in risk profile investigated were changes in mortality experiences. In this comparison, it was assumed that the microinsurer claims outgo changed (by varying the mortality rate experience in 2017) whilst premium income and all other expenses remained unchanged relative to the model microinsurer.

An increase in the mortality rate would lead to an increase in the risk per policyholder and should thus result in a greater capital requirement. This was due to a higher mortality rate being associated with a greater variance in that rate and thus more risk. It was also due to the microinsurer having a lower profit margin and thus being more vulnerable to making a loss. One would thus want the capital requirement to be greater for microinsurers with worse mortality experience to account for the larger risk and vice versa.

Figure 9.3 shows how the capital requirement, as a proportion of the sum-at-risk, changes as the mortality rate varies in 2017. The SCR increases as the mortality rate increased and thus responds appropriately to the increase in risk. This change is as would be expected given that there are two risk modules that allow for mortality risk.

In contrast to this, the MICR remained constant as a portion of the sum at risk as the mortality rate changed. This was what was expected given that there is no allowance for mortality risk in the microinsurance capital requirement. This was thus a weakness of the MICR as the largest risk the insurer faces is not allowed for in the capital requirement directly.

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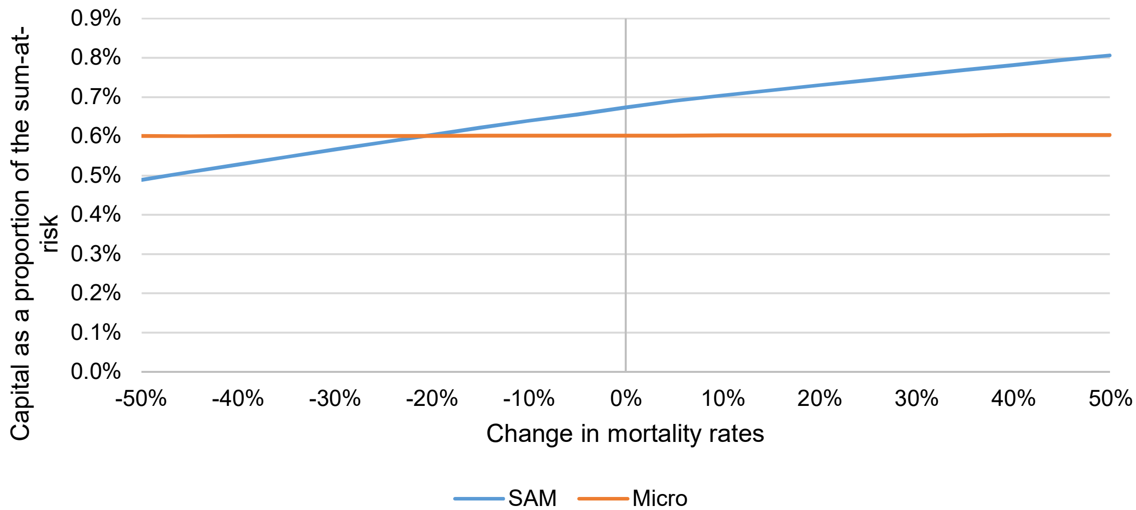

Figure 9.3: Impact of different mortality rates on the capital requirement as a proportion of the sum-at-risk

The risk is, however, allowed for indirectly if the premium rates charged by the microinsurer are adjusted upwards if mortality experience worsens. The MICR would then increase as the premium rates are increased as was shown in Figure 9.2. Thus, for this simplified capital requirement to be appropriate to protect against the largest risk of the microinsurer, the regulator would have to ensure that the premium rates charged are appropriate. This was likely to be the main reason why the regulator requires the actuary to sign off on the premium rate charged by a microinsurer. It is thus very important that the actuary ensures that the premium rates charged are appropriate.

9.2.4 Microinsurers with different lapse experience

The next change in risk profile investigated was changes in lapse experience. In this investigation, it was assumed that the insurer lapse experience changed over 2017 whilst premium rates, claims rates and all other expenses remained unchanged relative to the model microinsurer.

It was less clear how the change in lapse rates would impact the risk that the insurer faces. On the one hand, an increase in the lapse rate will decrease the number of policies in-force which can contribute to the overheads, increasing the risk of insolvency for the insurer. On the other hand, where the insurer holds a positive reserve for the policy in-force, lapsing would result in an immediate release of the reserve as profit. This would be the case with regards to the UPR reserve held by the insurer per policyholder.

Both the MICR and SCR increased, as a proportion of the total sum-at-risk in force at the end of the year, as the lapse rate increased (see Figure 9.4). The reason for this was the same for both solvency regimes. A higher lapse rate meant the insurer earned more income over the year relative to the number of policies in-force at the end of the year. To see this, consider a simplified

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example where there are thirteen policyholders at the start of the year and one lapsed in each month. We would thus have 1 policyholder at the end of the year but would have earned income for 78 policyholder months over the period. For the microinsurance regulation, the entire capital requirement would be influenced by this. For the SCR, only the operational risk premium is influenced by the premium income earned which was why it was less sensitive to the lapse rate.

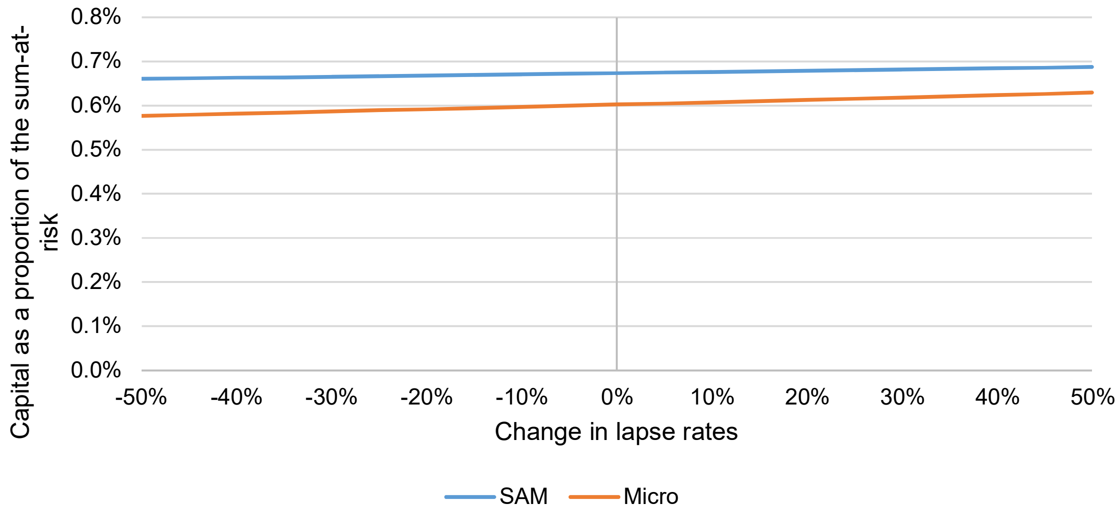

Figure 9.4: Impact of different lapse rates on the capital requirement as a proportion of the sum-at-risk

Because an increase in lapses can result in both an increase and decrease in risk, depending on the context of the lapses, it was thus unclear whether either requirement appropriately allowed for lapse risk.

9.2.5 Microinsurer growing at different rates

The next area of interest was how a microinsurer's capital requirement differed if it was expanding rapidly or was closed to new business.

For this scenario, a rapidly growing insurer was defined as one which had a new business growth rate of 100%, i.e. it sold twice the amount of new business in the 2017 relative to 2016. A microinsurer closed to new business was defined as one which sold no new business and it was assumed that the microinsurer stopped selling new business at the start of 2016.

One could argue that a microinsurer under both of these scenarios would face higher risk than the model microinsurer. For a rapidly growing microinsurer, this was due to the additional expenses from expansion which would lower the insurer's profit margin making it more vulnerable to adverse experience.

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For an insurer closed to new business, the change in the insurer's risk profile was less clear. On the one hand the insurer would have fewer policies to cover its overhead expenses lowering its profit margin which results in the insurer being more vulnerable to losses. On the other hand, the insurer would have no acquisition expenses which may thus offset the larger overhead expenses per policy, at least in the short term.

Figure 9.5 shows the SAM SCR and the MICR, as a proportion of the sum-at-risk, for a rapidly growing microinsurer and one closed to new business compared to the model microinsurer (base). The capital requirement for both the SAM SCR and the MICR are lower for a microinsurer that is growing rapidly than the base microinsurer. Thus, both fail to allow for the potential additional risk that arises from an insurer that is growing too rapidly.

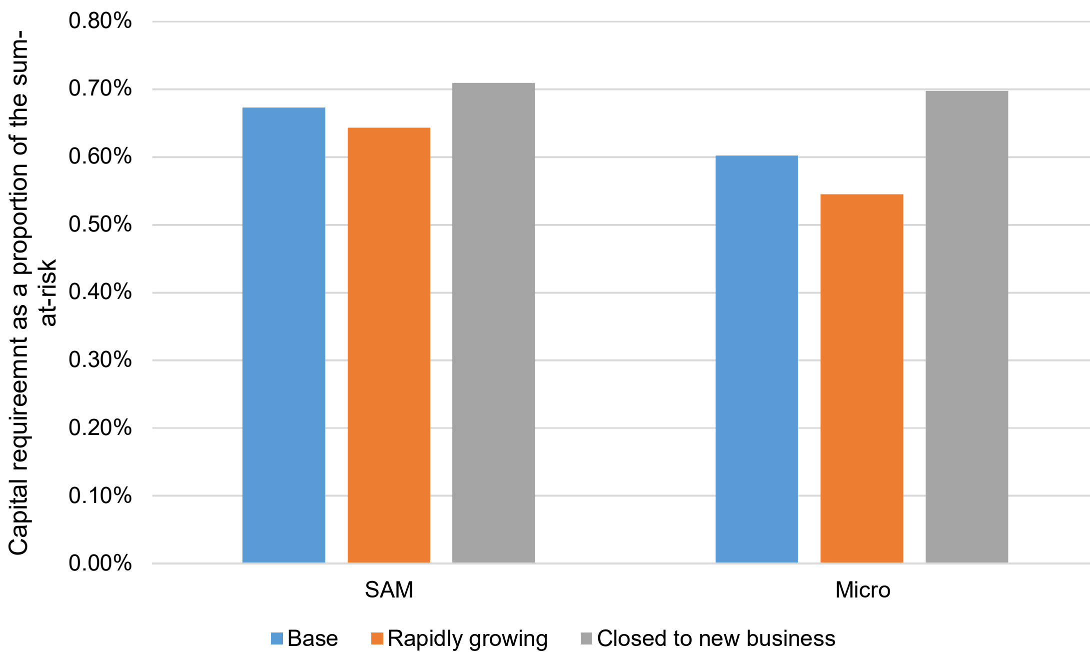

Figure 9.5: Comparison of capital requirement as a proportion of the technical provisions for insurers growing at different rates

The reason for this lower requirement is the same for both the SAM SCR and MICR. The capital requirements at the end of the year are based on the experience over the entire year whereas the risk measure, the sum-at-risk, is based only on the number of lives assured at the end of the year. Similar to the explanation in Section 9.2.4, if there was one life assured at the start of the year and ten lives assured at the end of the year then the capital requirement would be based on an average of five lives assured over the period whereas the risk at the end of the year is based on ten lives assured. There is thus a delay in both capital requirements in accounting for the

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increase in the microinsurer's risk from new business. This delay is amplified when the microinsurer is growing rapidly as in this scenario.

Figure 9.5 also shows that the MICR decreases by a larger amount relative to the base than the SAM SCR. This is due to approximately 60% of the SAM SCR being based on the mortality and catastrophe risk modules which are based only on the number of lives assured at the end of the year. This is as opposed to the MICR which is based only on premium income over the year which will depend effectively on the average number of lives assured over the year. The remaining 40% of the SAM SCR is made up mostly of the expense and operational risk modules which are also influenced by the average number of lives assured over the year. This meant that whilst both capital requirements did not allow for the additional risk arising from a rapidly growing microinsurer, the MICR was worse at allowing for this risk than the SAM SCR.

By contrast, for a microinsurer closed to new business the opposite was true. The capital requirement increased as a proportion of the sum-at-risk for both capital requirements. This was also due to the capital requirements being based on the average number of lives assured over the year whereas the risk measure was based on the number of lives assured at the end of the year. In this case there would be more lives assured on average during the year than at the end of the year which is why the capital requirement increased as a proportion of the sum-at-risk. The SAM SCR was again less impacted by the delay since the two mortality risk modules depend on the number of lives assured at the end of the year. It thus appeared as if both capital requirements allowed for the additional risk arising from a microinsurer closed to new business.

9.2.5.1 Different lapse experience for a microinsurer closed to new business

However, as mentioned above, it is not as clear cut as to whether a microinsurer which is closed to new business has greater risk than the model microinsurer. The argument with regards to the increased overhead expenses per policy only holds if the microinsurer cannot decrease these expenses as the number of lives assured decreases. This is only likely to be the case if the microinsurer is experiencing a large number of lapses when closed to new business and thus does not have sufficient time to decrease overhead expenses to match the decrease in lives assured.

It was thus important to see how the capital requirement changed for a microinsurer that was both closed to new business and experiencing a large number of lapses to see if this risk was allowed for appropriately. Figure 9.6 shows that the capital requirement does increase slightly as the lapse rate increases so this risk does seem to be captured to some extent. The MICR is more sensitive to the changes in the lapse rate for the same reasons as described above. It was thus not clear whether either requirement appropriately allowed for the risk of an insurer closed to new business and experiencing a high number of lapses.

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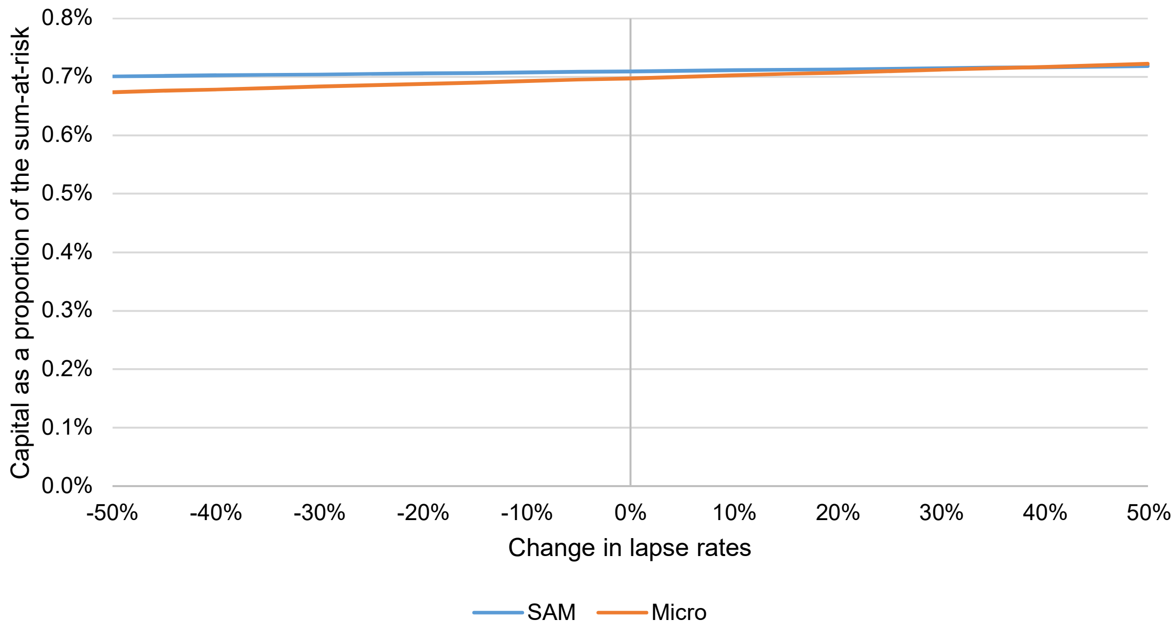

Figure 9.6: Impact of different lapse rates on the capital requirement of a microinsurer closed to new business

9.2.5.2 Different premiums charged for a microinsurer growing at different rates

Another area of interest was to see how the risk arising from charging different premium rates, as was discussed in Section 9.2.2, affected the capital requirements of insurers growing at different rates. As discussed previously, the MICR decreases as the premium rate decreases which meant that the microinsurer is required to hold less capital as its risk increases. There was however a lower limit which effectively worked as a safety net to limit the amount by which the insurer could lower its capital requirement by decreasing its premium rates.

Figure 9.7 shows that the required decrease in premium rates is larger for a rapidly growing microinsurer relative to the model microinsurer before this lower limit comes into effect. The safety net is thus much less effective as the insurer can benefit from a lower capital requirement by decreasing its premium rates up to 30%. At this stage the insurer would be extremely high risk as it would be making significant losses and yet hold a significantly lower capital requirement than if it was charging an appropriate premium rate.

The weakness that was highlighted in Section 9.2.2 is thus worse for a microinsurer that is growing rapidly. It is also likely that in such a scenario it would also be charging low premium rates to attract all the new business. This scenario thus again highlights the importance, from a regulatory perspective, that the premium rates charged by a microinsurer are appropriate for the risk it is taking on.

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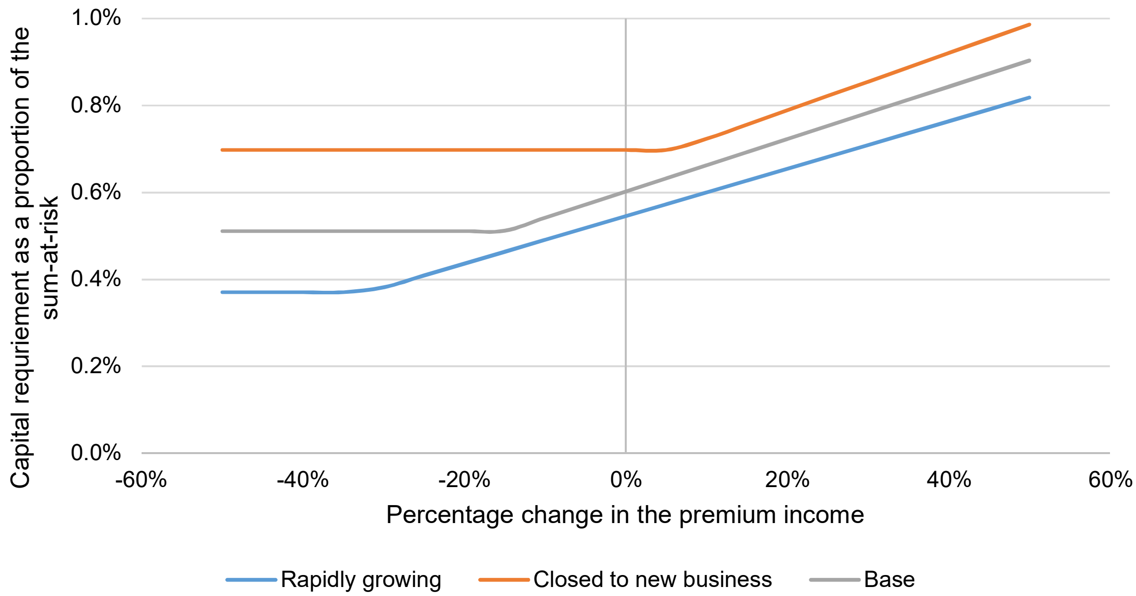

Figure 9.7: Impact of charging a different premium rate on the MICR of a microinsurer with different growth rates

For a shrinking insurer the lower limit will take effect after a 5% increase in premium rates. The reason was that a shrinking microinsurer is always likely to earn less premium income in each successive year unless the additional income from a premium increase exceeds the lost income from lapses. This weakness was thus not an issue for a microinsurer closed to new business.

The SAM SCR under the scenarios mentioned above behaved similarly to a microinsurer growing at normal rates (discussed in Section 9.2.2). The results are shown in Appendix B.1.1.

9.2.6 Comparison of different sized microinsurers

A comparison was also done with microinsurers of different size. This was allowed for in the model by changing the starting number of lives assured assumed in the model. Since both capital requirements change proportionally to the number of lives assured, there was no additional insight from this comparison. The results of the comparison are provided in Appendix B.1.2 for reference.

9.3 COMPARISON OVER A TEN-YEAR PERIOD

The next step in the comparison was to compare the capital requirements over multiple years. Similar comparisons of the capital requirements shown in the previous section were looked at, but over a ten-year period. The purpose was to see how the two capital requirements behaved for different types of microinsurers over the long term. It was found that the results did not differ significantly when looking at a longer time period.

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9.3.1 Model microinsurer

The comparison of the SAM SCR and MICR over a ten-year for the model microinsurer is shown in Figure 9.8. Initially, the SAM SCR exceeds the MICR, but after about seven years, this relationship inverts with the MICR exceeding the SAM SCR.

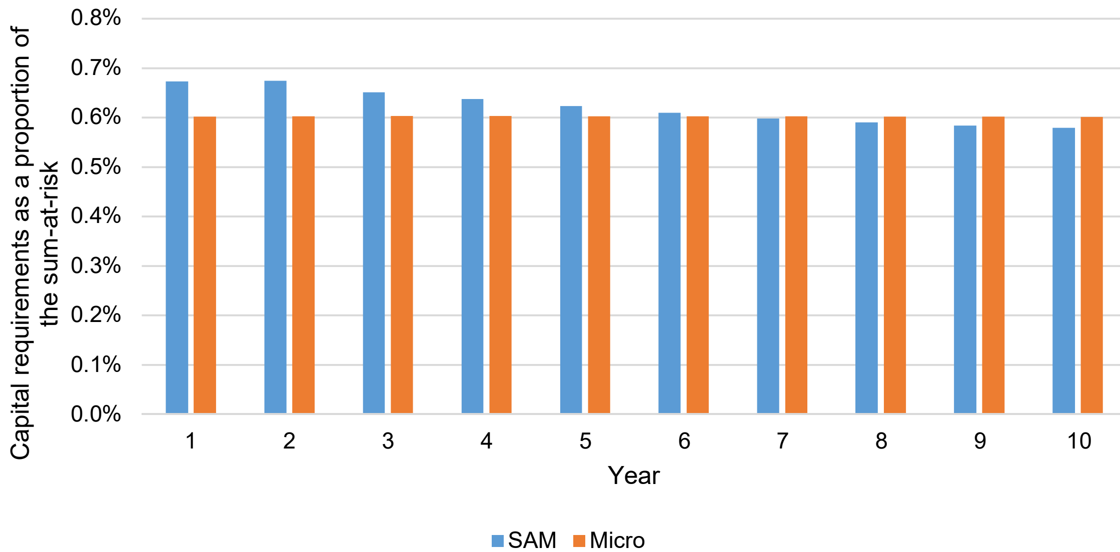

Figure 9.8: SAM SCR versus MICR over a ten-year period for the model microinsurer

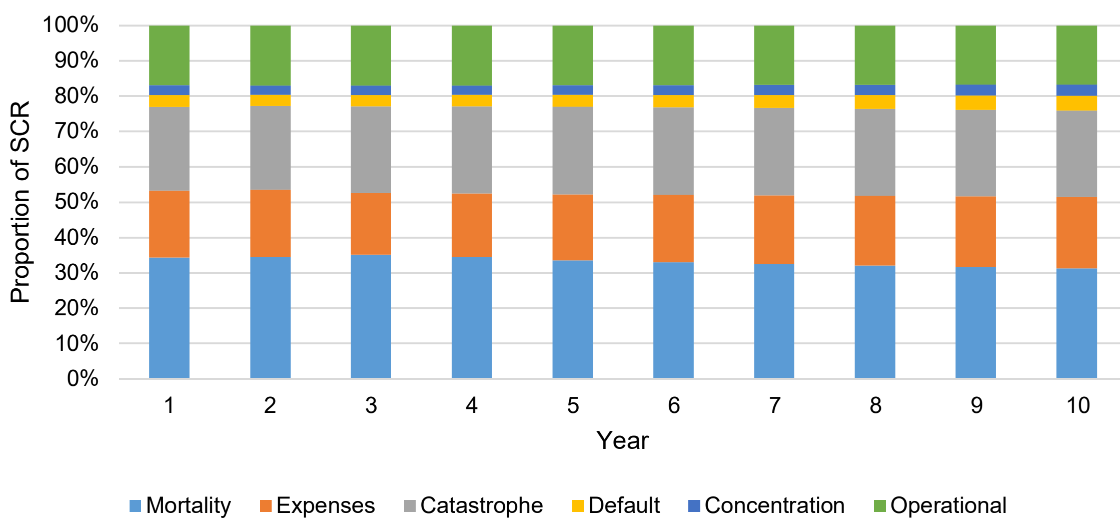

Figure 9.9: Size of each risk module after diversification as a proportion of the SCR over a ten-year period

The reason for the inversion was due to improving mortality rates over time, i.e. the mortality rates used in the model were decreasing over time. This meant that the largest risk module in the SAM

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SCR, mortality, was decreasing over time. Figure 9.9 shows how the mortality risk module fell from approximately 34% of the SCR to 31% over the ten-year period.

The trend shown in Figure 9.8 therefore reiterates the findings in Section 9.2.2 and 9.2.3, namely that the SAM SCR responds to the changing risk profile of the microinsurer over time whereas the MICR generally does not. To see why consider how the microinsurer's risk profile changes over the ten-year period. As the mortality rate decreases the microinsurer number of claims per policyholder decreases whereas its premium per policyholder remains the same in real terms. Thus, the microinsurer's profit margin per policy increases over time. As the microinsurer's profitability increases, its risk decreases as it is less vulnerable to losses. The SAM SCR decreases over time to reflect this lower risk whereas the MICR remains unchanged.

Considering the reverse of this situation shows why this feature of the MICR is a possible issue. If the mortality rates were assumed to increase over time, then the microinsurer would have a lower profit margin. A microinsurer that is less profitable has additional risk as it is more vulnerable to loss. In such a situation the SAM SCR would increase as a proportion of the sum-at-risk to reflect the larger risk whereas the MICR would remain the same.

This assumed that the microinsurer would not change its premium rates in light of the changing claims experience. If the microinsurer did adjust its premium rates to reflect the new claims rate, then the MICR would also adjust appropriately to reflect the new risk level.

The results would seem to indicate that a microinsurer that would want the lowest regulatory capital requirement would initially make use of the simplified MICR and then move to the SAM solvency regime as the insurer becomes more mature. The regulator would also likely find the situation acceptable. The microinsurer would initially benefit from the simple MICR when starting up and thus meet the regulator's goal of assisting smaller microinsurers competing with larger ones. Over time, microinsurers would move over to the SAM SCR to benefit from the lower capital requirements. This would ensure that the microinsurer's risk profile is more appropriately reflected in its capital requirement as the insurer becomes larger and more mature.

9.3.2 Other microinsurer comparisons

The impact of changing risk profiles on the capital requirements over a ten-year period did not differ substantially from the one-year impact. The results of these changes can be found in Appendix B.2.

9.4 SUMMARY

This chapter showed that the MICR proved to be a surprisingly good approximation for SAM SCR with both producing similar capital levels for the model microinsurer. However, when considering microinsurers with different risk profiles the weaknesses of the MICR quickly became apparent.

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Because the MICR is only based on premium income, it is very insensitive to changes in risk profiles. The only way that it would sufficiently capture changes in risk is if the premium rates are adjusted appropriately to reflect the change. The most important result of this chapter was thus that the MICR is only a suitable alternative to SAM if the premium rates charged by the microinsurer fully reflect the risk of the microinsurer.

There were however weaknesses that were shared by both capital requirements. Neither captured the additional risk of a microinsurer growing rapidly. They also did not appear to allow for the risk that arises from changes in lapse rates.

To have a better understanding of the extent of the weaknesses noted in this section does require some form of quantification of the risk. This is done in the next two chapters which describe the results of the capital adequacy tests performed.

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CHAPTER 10
DETERMINSITIC TESTING OF THE CAPITAL ADEQUACY

10.1 INTRODUCTION

This chapter will focus on the deterministic tests used to assess the level of protection provided by the capital requirements, namely the reverse stress test and scenario analysis. For each test, a description of how it was carried out is provided. The results are then shown as well as a discussion on the implications of the results.

10.2 REVERSE STRESS TESTING

Reverse stress testing (as defined in Section 7.3.1.2) was used to determine the percentage change in an individual model variable that resulted in the depletion of the insurer's regulatory capital. The purpose was to identify the areas of risk which the insurer was most vulnerable to. To identify these risk areas, both the percentage change and the likelihood of that change is required for each variable tested. Thus, where possible, a high-level analysis was also performed on the likelihood of the particular stress occurring.

10.2.1 Description of the test

The test was conducting by determining what value of the variable would result in a loss over a one-year period (the 2018 financial year for the model) that would exceed the regulatory capital the insurer held at the start of the year. The percentage change was found using Excel's Goal Seek function. It was also possible to determine the size of the stress leading to insolvency by considering the impact of the change as a proportion of the original premium income (i.e. the premium income the insurer would have earned had the variables not been stressed). This provided a useful check on the results produced using the Goal Seek function. This approach is best described when considering an example and is thus discussed in more detail in the results section below.

The types of variables that were stressed were divided into two groups. The grouping is discussed in the next section.

10.2.2 Results of the test

10.2.2.1 Premiums rates, mortality and expenses

The first group consisted of premium rates, mortality rates and expenses. These three variables have been grouped together as they are all directly related to the insurer's profit. This was because the direction (i.e. increase or decrease) of the change in profit always depended on the

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direction of the change of the stressed variable. For example, a decrease in premiums would always result in a decrease in profit, all else being equal.

The stresses required for the insurer to go insolvent can be derived by considering the impact of the change as a proportion of the original premium income. To see why, consider the stress applied to the premium rates. The change in the premium rate required for the insurer to go insolvent was a 33.5% decrease if the insurer was holding the SAM SCR and 29.5% for the MICR. This was derived as follows for the SAM SCR. The profit margin of the insurer was equal to 7.5% of premium income and the SCR was equal to approximately 15% of the premium income. Thus, ignoring all else, a decrease of 22.5% of the original premium would exhaust the capital held. However, some of the decrease in premium income would be offset by a decrease in expenses. Since commission was a fixed 20% of premium income it would also decrease by 33% under the stress. Thus, the commission cost would decrease from 20% to 13% of the original premium income. The operating cost also decreased by approximately 4% of the original premium income (the decrease was less pronounced than the commission cost since a portion of this cost was fixed). Thus, the total decrease required was therefore the 22.5% plus the offset from the cost savings (7% for commission and 4% for operating expenses) resulting in the 33.5% stress required under the SAM SCR.

For the MICR, a similar argument can be made. The main difference is that the MICR is only 11% of the premium income in 2018 (The capital held at the start of 2018 would be based on 15% of the premium income in 2017).

Similar arguments were also made for mortality rates and expenses. The results of the reverse stress test for all three of the variables are shown in Figure 10.1. As can be seen from the figure, the insurer's solvency is most sensitive to a change in premium rates and least sensitive to a change in expenses.

This was as expected since a change in premium will impact the entirety of the insurer's income (excluding investment income). Changes in mortality would only impact the 43% of the premium income that went towards paying claims. Changes in expenses would only impact the 30% of premium income that went towards operational and acquisition costs (commission is excluded from the expense stress test, because it was assumed to remain a fixed proportion of the premium income and was thus not stressed).

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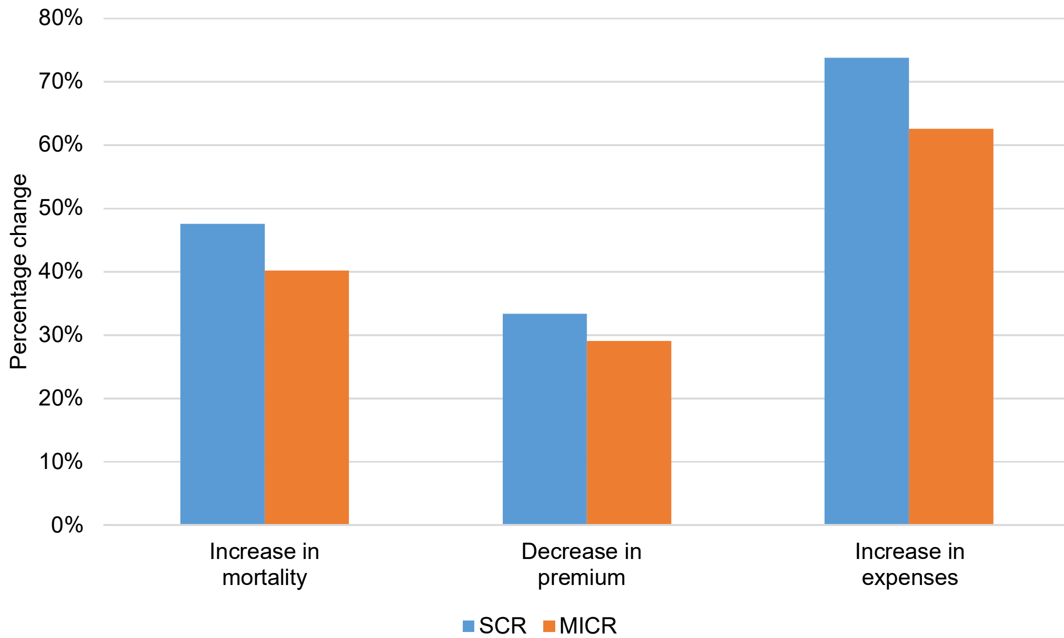

Figure 10.1: Percentage change in variable that results in the insurer going insolvent

The large vulnerability to premium rates again highlights the importance of a microinsurer charging appropriate premium rates. The roughly 30% change in premium rates that would result in the insurer going insolvent may seem a bit extreme if one considers all the processes and controls used by insurers when repricing products. But the MICR is aimed at smaller insurers which may not have processes and controls in place that meet the same standard as the larger insurers. There are studies that show (see Section 2.5) that the pricing methods used by many informal insurers are not always sound. The industry is also very competitive which also adds pressure to microinsurers to lower their premium rates. These factors, combined with the capital benefit of lowering premium rates discussed in Section 9.2.2, arguably show that a 30% decrease in premium rates may be less extreme than one might initially think.

The results also indicate that, when considered individually, mortality risk is a greater threat to the insurer's solvency than expenses. This makes intuitive sense since the purpose of funeral insurance is to transfer mortality risk from the policyholder to the insurer. It is also in line with the composition of the SCR (see Figure 9.1) where the two mortality risk modules (mortality and catastrophe) are significantly larger than the expense risk module.

The required change in mortality rates for insolvency over a one-year period was somewhat higher than the SAM stress of 15% which might indicate that a 40% change was unlikely. However, a study (Continuous Statistical Investigations Committee, 2007: 9) of funeral mortality rates from 2001 to 2002 showed that claims rates varied significantly between provinces. The

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mortality rates in KwaZulu Natal, which had the highest rates, were more than double that of the rates in the Western Cape, the province with the lowest rates (Continuous Statistical Investigations Committee, 2007: 9). Thus, a 40% change may not be so farfetched in a scenario where a microinsurer prices for the average mortality rate in South Africa, but ends up writing more business in provinces with worse mortality experience.

The likelihood of the expense stresses, 63% for MICR and 74% for SCR, was analysed by considering how expense levels can vary between insurers. Münstermann, Vogelgesang and Paulus (2015), who worked for McKinsey & Company, found that operating expenses could differ by up to 80% between the best and worse insurers. They also found that management was the driving factor when it came to controlling expenses. Thus, it is possible that a change in management could lead to a significant increase in expenses. This stress thus seems to be in line with the extreme scenario that the capital requirement is supposed to protect the insurer from.

The variation in acquisition cost between companies is likely to be even greater than for operating costs. This is due to the large variation between the growth strategies pursued by different insurers. Of interest was what the impact would be of a microinsurer growing at more rapid rates than assumed in the base scenario. This scenario will be considered in more detail in Section 10.3.2.3.

10.2.2.2 New business rate and lapse rate

The second group of variables stressed were the lapse and new business rates. These variables are considered separately from the other variables as their impact on the insurer's profit was indirect. This was because the direction of the change in profit did not depend on the direction of the change of the stressed variable alone. For example, an increase in new business could result in either an increase or decrease in profit.

To see why, consider the following examples. An increase in new business will lead to an increase in premium income which would boost profit (assuming the business written is profitable). This would however also lead to an increase in acquisition cost, as this is a fixed cost per policy, and operating expenses, where the increase from year to year depended partly on the growth in lives assured, which lowers profits. Which of these two forces would be the largest depends on the magnitude of the change in the new business rate and the corresponding change in expenses.

Similarly, an increase in lapse rates may initially increase profits as the insurer will have received premium income for policies that no expenses or claims need to be paid for. (The extent of this will depend on how closely the monthly benefits are matched to expenses.) On the other hand, the insurer will also have fewer polices to spread overhead expenses over which will then decrease profits per policyholder.

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Thus, the direction of the change in the insurer's profit depends on both the direction and magnitude of the change in the new business or lapse rate. Figure 10.2 shows the required monthly new business and lapse rates that would result in the insurer becoming insolvent for both the SCR and MICR relative to the base rates assumed in the model. These rates are shown as monthly rates as the impact of the stress is easier to understand when one looks at the policyholder movement on a monthly basis.

The monthly lapse rates leading to insolvency, 32% under SAM and 25% under the MICR, are very large rates. This insolvency stress is thus more representative of a mass lapse scenario as opposed to a general increase in lapses. Whilst this scenario is modelled as several consecutive months of high lapses in this thesis, it is arguably easier to assess the business implications of such a scenario if it is considered as a mass lapse situation. This approximation seems reasonable since at 32% per month, approximately 80%* of the business would have lapsed after four months – a fairly short period of time.

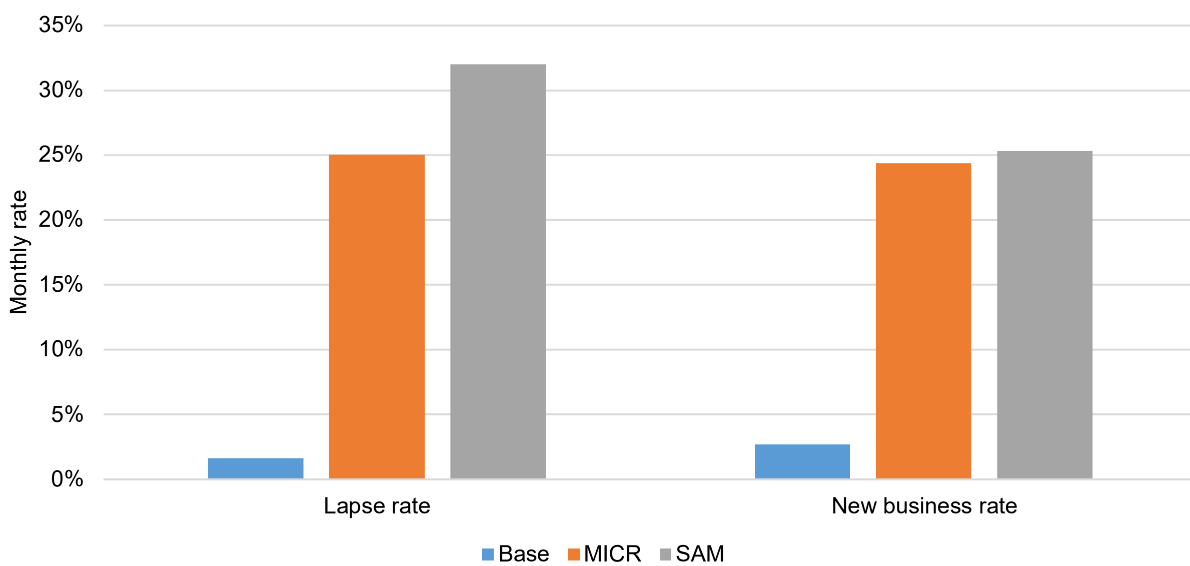

Figure 10.2: Monthly rate resulting in insolvency relative to the base.

Such a large lapse is likely to be an extreme event. Such a situation may occur if one or two brokers with which most of the microinsurers policies are held decide to leave. To provide some context, the SAM mass lapse shock for group policies† is 70%. The mass lapse shock that leads to the insolvency for the model microinsurer is thus larger than the SAM shock.

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* $(1 - 32\%)^4 \approx 20\%$, thus only 20% of the business is still in-force or 80% has lapsed.
† Group policies was deemed a more appropriate comparison than individual since the funeral insurance policies are often sold by brokers who may move their clients to different insurers, similar to group policies.

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Because the main risk of lapses lies with the insurer not being able to cover operational expenses, this is predominately a shareholder risk rather than a policyholder risk. To see why, consider an extreme example. If all policyholders lapsed today the insurer would be insolvent since it would have no premium income to cover its expenses. However, there would be no risk to policyholders of claims not being paid since there would be no claims (assuming all historical claims have been settled).

In the stress explained above the insurer is likely to have to settle all claims before paying expenses and thus it will be the insurer staff, shareholders and debtors that will lose out. The policyholder should in theory not lose out at all from the insurer's insolvency since there is no early termination benefit for the policyholder. The short-term nature of the contract means that the policyholder should be able to get the same policy from another insurer at a similar price.

Since regulators are mostly concerned with the risk to the policyholder, they should in theory not be concerned about lapses on their own. This is also shown by the fact that the SCR module for lapse risk is not applicable to insurers with short contract boundaries as discussed in Section 8.3.5.1.

Of course, in practice there may be other consequences such as the policyholder being subjected to a new waiting period if they have to switch microinsurers, although the regulation currently forbids this. There is also a chance that if the regulator is too slow to intervene, the insurer may pay its expenses before settling all claims.

Once again, the size of the stress can be derived by considering the original premium income. For the lapse rate, the stress implied that roughly 80% of the microinsurer's policies in force at the start of the year would have lapsed after about 4 months. This results in the insurer only earning 30% of the premium income it would have had it not experienced the stressed lapses (this is more than 20% as some of the lapsed policies would have paid premiums in the months before they lapsed). The insurer would also be holding 15% of the premium income before the stressed lapses as SCR. The microinsurer's outgo, excluding operational expense, under this scenario would be 25% of pre-stressed premium income. Finally, the microinsurer would need to pay operational expenses, which is partly fixed as discussed in Section 8.3.3.4, of around 20% of premium income. Thus, the microinsurer would be at the point of insolvency in this scenario. The main driver of this was the fixed nature of the overhead expenses. The risk from lapses thus arguably arises predominately from the overhead expense of the microinsurer.

The final stress was applied to the new business rate. As is shown in Figure 10.2, a monthly new business rate of 24% and 25% would lead to insolvency under the MICR and the SCR respectively. This rate would result in the doubling of the in-force book of business every three months. Such a situation may be more likely for a new smallish insurer than the model

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microinsurer where it was assumed that there were 300 000 lives at the outset of the modelling period. However, these results will still hold even if it is assumed that the microinsurer had fewer lives assured at outset and thus the risks highlighted below are still relevant.

Another point noted in the figure was that the new business rate per month that leads to the insurer becoming insolvent was surprisingly close under both the SCR and the MICR given how the two differed somewhat for the monthly lapse rate stress. The reason for this was the exponential decrease in the net profit of the microinsurer after the monthly new business rate exceeds roughly 10%. As can be seen form Figure 10.3 the microinsurer's profit initially increases as the new business rate increases. This is because only accidental death claims are paid on these policies which would still be in the waiting period. However, the additional expenses from selling so many policies starts to exceed the additional premium income earned after the new business rate reaches 10% per month.

The reason why the net profit decreases exponentially after this point is because new business grows exponentially. This is a consequence of applying the new business rate to the number of lives in-force in the previous month. The compounding of the growth in new business results in a similar compounding of the expenses.

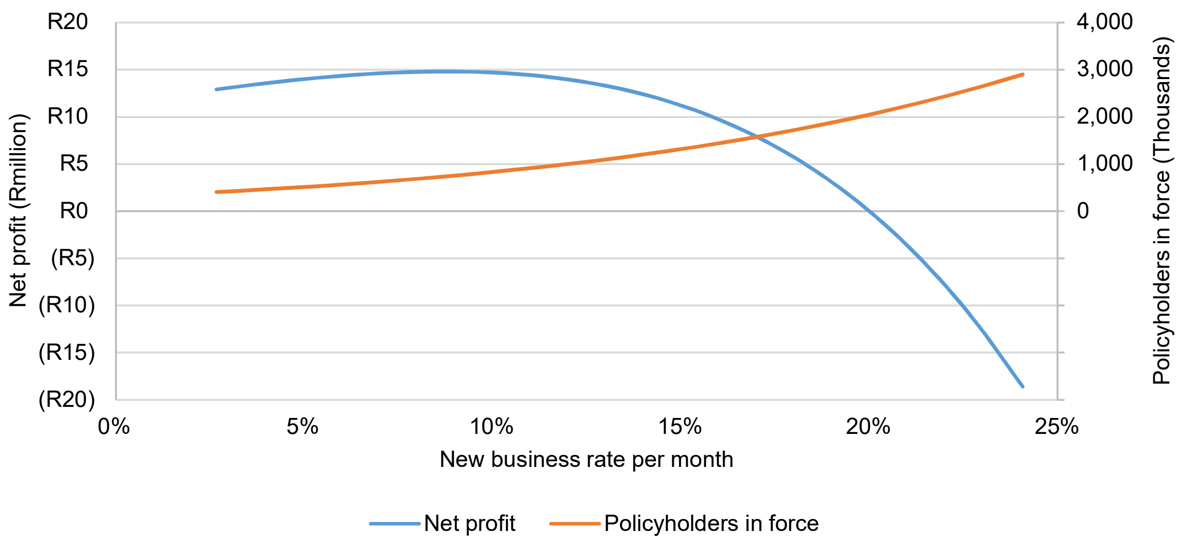

Figure 10.3: The net profit (before tax) and number of lives assured at the end of the year for different monthly new business rates

This does however demonstrate how quickly the insurer can go from earning additional profit to going insolvent from growth in its new business. The additional profit initially made may also induce a false sense of security which may mean that the microinsurer spends less time monitoring its solvency position in a scenario of rapid growth. This risk is also more concerning

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given that neither the SCR or the MICR allows for the additional risk from writing large amounts of new business as discussed in Section 9.2.5.

A counter argument to the above is that an insurer growing this rapidly should be able to raise additional funds to cover the additional expenses. The policies sold should be profitable in the long-term and thus the loss essentially arises from a cash flow issue. However, this is still a real risk to policyholders who will not have their claims paid if the insurer cannot raise the additional money in time. The new business rate could thus be an additional source of risk which is not appropriately captured in either capital requirement.

10.2.3 Conclusion

The results of this section highlighted that the main risk to the funeral insurer is charging an inadequate premium rate. It also highlighted that mortality risk is of a greater concern than expense risk as would be expected for a funeral insurer. The results further showed that both lapses and new business are sources of risk, but that both come with caveats. The risk from lapses is more of an issue for shareholders as opposed to policyholders. The risk from new business mostly arises from a cash flow perspective.

The above test only looked at changes to variables in isolation. This will not capture additional risks that may arise from two variables changing at the same time. This is considered in the next section.

10.3 SCENARIO ANALYSIS

A scenario analysis was used to determine the impact on the insurer solvency of changing more than one variable at a time. The narratives used to create the scenarios can be quite complex and detailed since they would form part of an insurer's risk management and mitigation strategy. However, for the model used in this thesis, it was not feasible to construct detailed narratives as these would depend on the context in which the insurer operates. The microinsurer in this thesis was designed to represent the industry average and thus did not have the context required for a detailed narrative.

Instead, a pragmatic approach was followed. This involved assessing the impact on the insurer's solvency position of changing two variables at a time. A high-level description of the situation where the dual stresses could occur is also provided to help with assessing the likelihood of such a scenario.

This test helps to deal with the gaps in the reverse stress tests since it could be used to identify situations where insolvency was unlikely when considering an individual stress but may be much more likely when considered in conjunction with a stress in another variable.

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10.3.1 Description of the test

Seven different scenarios were investigated for this test. The first six scenarios involved varying one of the group of variables that directly impacted profit (premiums, mortality and expenses) and one of the movement rates (lapses and new business rates). The main purpose of these scenarios was to determine if the insurer became more vulnerable to changes in premiums, mortality or expenses if the insurer was experiencing different policyholder movements.

The final scenario involved changing the two movement rates simultaneously. This was used to investigate the impact on the insurer's solvency of both a high lapse rate and new business rate occurring simultaneously.

A summary of the scenarios is shown in Table 10.1 with the results discussed in the next sections.

Table 10.1: Scenarios tested

Scenario number	First stressed variable	Second stressed variable	Situation from which the combination could arise
1	New business rate (↑)	Premium rate (↓)	Lowering premium rates leads to a surge in new business
2	Lapse rate (↑)	Premium rate (↓)	Competition leads insurer to lower premiums, but it is not sufficient to prevent the loss of business
3	New business rate (↑)	Expenses (↑)	Increased new business leads to poor expense controls, for example from staff being overworked or the cost of implementing new systems
4	New business rate (↑)	Mortality rates (↑)	Surge in new business, but where policyholders are selecting against the microinsurer
5	Lapse rate (↑)	Mortality rate (↑)	Selective lapsing by policyholders
6	Lapse rate (↑)	Expenses (↑)	Low persistency coupled with poor expense control
7	Lapse rate (↑)	New business rate (↑)	Fast growing business with a low persistency rate, possibly from misselling

10.3.2 Results of the test

10.3.2.1 Impact of new business on the premium rate stress

The first scenario considered was a combination of a premium decrease and an increase in new business. Such a situation could arise where the microinsurer lowered its premiums rates to become more competitive. The strategy turns out to be effective and the microinsurer experiences a surge in new business due to being cheaper than its competitors.

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The scenario was analysed to consider the size premium cut that would result in the insurer going insolvent for different monthly new business rates. This could then be used to determine if the risk from decreasing premium rates was lower or higher when this change is accompanied by an increase in new business.

Figure 10.4 shows the results of the scenario*. The figure shows that the microinsurer solvency initially becomes less vulnerable to changes in premium rates as the new business rate increases, but then becomes more vulnerable. (There was no significant difference between the results of the two capital requirements.)

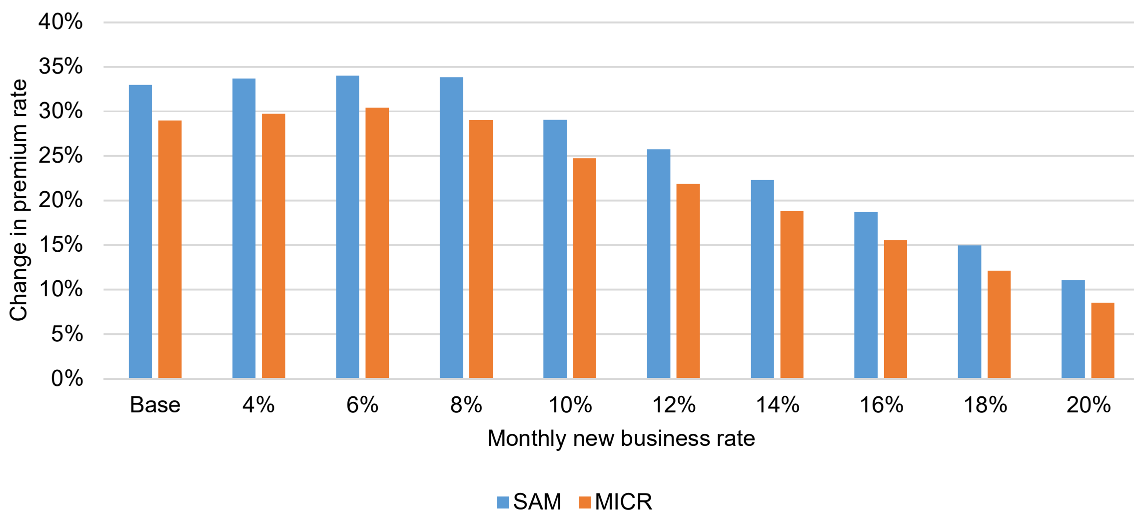

Figure 10.4: Change in the premium rate that results in insolvency for different monthly new business rates

The reason for this is similar to the explanation provided in Section 10.2.2.2. The microinsurer initially benefits more from the additional premium income it earns from the new polices on which only accidental claims are paid for the first six months. However, after the new business rate exceeds 10% per month the additional expenses exceeds the additional premium income. At this point the microinsurer's profit margin starts to decline. It can thus only sustain a smaller decrease in premium income from the base rate and still remain solvent.

This means that the larger the new business growth induced by the premium cut, the greater the risk to the microinsurer's solvency position to a decrease in premium rates. A microinsurer would thus need to carefully manage any decrease in premium rates when pursuing faster new business

* The base rate was 2.7%

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growth. If a microinsurer underestimates the growth in new business from a premium cut, then it could put its solvency position at risk.

10.3.2.2 Impact of lapses on the premium rate stress

The next scenarios also involved a decrease in premium rates, but in this case the goal of the microinsurer was to prevent the loss of business to competitors. Such a situation may arise where competitors are undercutting the microinsurer so as to attract its policyholders. It could also arise from a competitor offering a more innovative product. The scenario focuses on the situation where cutting the premium rates was not sufficient to prevent the large number of lapses.

Similar to the previous scenario, this scenario is performed by applying the premium rate reverse stress test to the model microinsurer for different monthly lapse rates. The influence of the lapse rate on the size of the premium stress that results in insolvency could then be assessed.

Figure 10.5 shows the result of the scenario. The figure shows that the insurer solvency becomes more vulnerable to a change in premium rates as the lapse rate increases (the base rate was 1.6%).

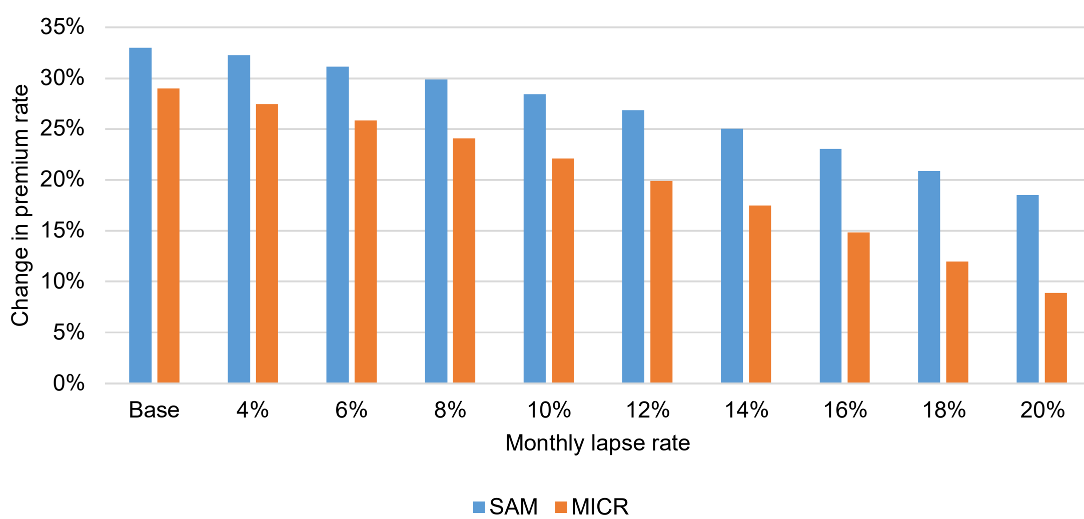

Figure 10.5: Change in the premium rate that results in insolvency for different monthly lapse rates

This shows that a microinsurer would need to carefully consider what it expects its lapse rate to be after cutting its premium rates. If the microinsurer cuts do not result in a sufficiently low enough monthly lapse rate, then it may put its solvency position at risk. For example, if the microinsurer cut its premium rates by 20%, but still experiences a monthly lapse rate of 12% then it will become insolvent. This situation could arise where the main reason the microinsurer is losing polices is not price related.

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10.3.2.3 Impact of new business on the expenses and mortality stress

The next two scenarios looked at how expense risk and mortality risk, respectively, changed as the new business rate changed. The first scenario considered a situation where the microinsurer was selling large amounts of new business, but where the new policies generally had worse mortality experience. This situation could be a greater issue for funeral insurers than other insurers due to the very limited underwriting.

The second scenario considered a situation where the insurer expense controls deteriorated as a result of selling large amounts of new business. This could be due to the additional cost from implementing new systems or hiring additional staff to administer the additional business written.

The results of these two scenarios are shown together to compare how the relative risk from mortality and expenses changed as the microinsurer's new business rate changed. As discussed in Section 10.2.2.1, mortality risk was found to be greater than expense risk when considering the variables individually. However, these two scenarios showed that the reverse was true when the insurer was experiencing high levels of new business growth.

The results of the two scenarios are shown in Figure 10.6[*]. Initially the microinsurer solvency is more vulnerable to stresses in mortality, but when the new business rate is 14% per month then the opposite is true. Thus, expense risk becomes a greater concern to the microinsurer when there is a large increase in the amount of new business.

The reason for this was that expenses and claims changed in different ways as the new business rate increased. As the new business rate increases the insurer acquisition costs and operating expenses increased significantly. This meant that the expenses of the microinsurer make up a larger portion of its outgo under such a scenario. The microinsurer's solvency thus becomes more sensitive to changes in expenses.

On the other hand, claims behaved differently as the new business rate increased. Under this scenario claims decreased as a proportion of premiums income. This is due to the waiting period which meant that only 10% of the claims from new business that was less than six months old would be paid. Thus, the microinsurer would receive fewer claims relative to the number of lives assured. The reason why the insurer does not become less sensitive to changes in mortality as the new business rate increases is because the insurer profit margin is lower under this scenario due to the increase in expenses from selling more new business described above.

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[*] This figure assumes the microinsurer held the SAM SCR. The results are similar when the microinsurer holds the MICR. This is show in Appendix B.3 in Figure B.5.

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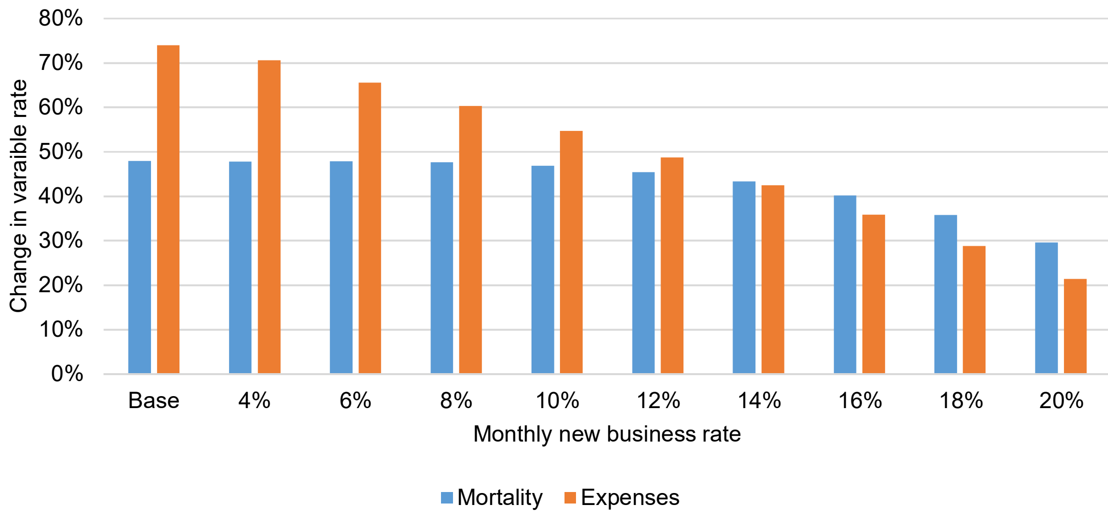

Figure 10.6: Comparison of the change in mortality and expenses that results in insolvency for microinsurers with different new business rates

These two scenarios demonstrated that expense risk can be of a greater concern to the microinsurer under certain circumstances. This means that the composition of the SAM SCR, which was more weighted to mortality risk, for the model microinsurer (shown in Section 9.2.1), may not sufficiently capture this risk in certain circumstances.

Further, because the calculation of the expense risk module is based on past expenses, no allowance is made for the increase in future expenses as a result of an increase in new business. It would thus take some time for the additional expense risk to reflect in the SCR. The MICR had a similar issue since the calculation is based on past premium income written. Thus, there was also no allowance for the microinsurer expected future growth under either solvency regime.

10.3.2.4 Impact of lapses on the expenses and mortality stress

The relative ranking of the microinsurer's mortality and expense risk also changed in a similar manner when it experienced higher lapse rates. To provide context to the scenarios that were investigated, they could be described as follows:

- The first scenario could represent a situation where the microinsurer experienced both poor expense control and an increase in lapses. This could arise in a situation where the insurer has system failures and needs to pay additional expenses to fix the errors. At the same time, system failures may inconvenience customers who subsequently lapse their policies.
- The second scenario could represent a microinsurer that was experiencing selective lapsing: where policyholders with better than average mortality experience lapse leaving the microinsurer with policyholders with worse than average experience.

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The results of the scenarios are shown in Figure 10.7*. The figure shows that the microinsurer initially becomes less vulnerable to changes in expenses and then more vulnerable as the lapse rate increases. This is because the insurer initially gains from having to pay fewer operational expenses as policies lapse as it is able to make some expense savings when it had fewer lives assured. However, when the lapse rate is sufficiently high the insurer is not able to make any additional savings on operational expenses which decreases its profit margin, making it more vulnerable to loss.

The extent of the risk thus depends on how well a microinsurer would be able to control its operational expenses in such a scenario. In the model used in this thesis, it was assumed that there would only be limited savings in such a scenario (see Section 8.3.3.4) as operating expenses were assumed to be fairly fixed in the short term. This may not be the case for all types of microinsurers.

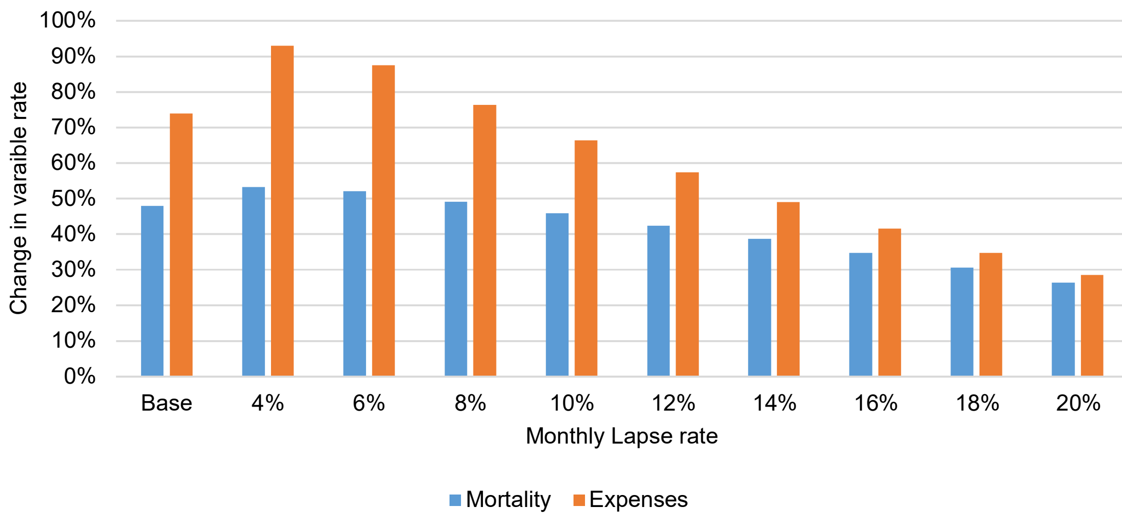

Figure 10.7: Comparison of the change in mortality and expenses that results in insolvency for microinsurers with different lapse rates

The results for the mortality stress scenario follow a similar pattern to the expense stress explained above. The difference is that the mortality rate stress was less sensitive to changes in lapse rates than the expense stress was. Thus, the risk of lives with lower mortality rates lapsing and those with higher mortality rates remaining is not much greater than the risk from the general deterioration in mortality experience (without changes in lapse experience) for a microinsurer. The reason why the microinsurer does become more vulnerable to changes in mortality at high

* This figure assumes the microinsurer held the SAM SCR. The results are similar when the microinsurer holds the MICR. This is show in Appendix B.3 in Figure B.6.

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lapses is mostly due to the increase in overhead expense per life assured that is a consequence of the higher lapse rates.

10.3.2.5 Increase in low persistency new business

The final scenario looks at a situation where both the new business and lapse rates are increasing. This could occur where the insurer is selling lots of new business, but the persistency of the new business is low. For example, brokers misselling policies which the assured life soon lapses after buying.

This approach differs to the previous scenarios. Both rates are changed simultaneously to the same value as opposed to changing one variable and then determining the stress that would need to be applied to the other variable for the microinsurer to go insolvent.

The change in approach allowed this situation to be analysed in one scenario as opposed to two scenarios that would be required using the previous approach. The first would have been to increase the lapse rate and determine the change in new business rate stress that would lead to insolvency. The second would have been to increase the new business rate and determine the lapse rate stress that would lead to insolvency. These two scenarios are very similar which is why they were combined into one.

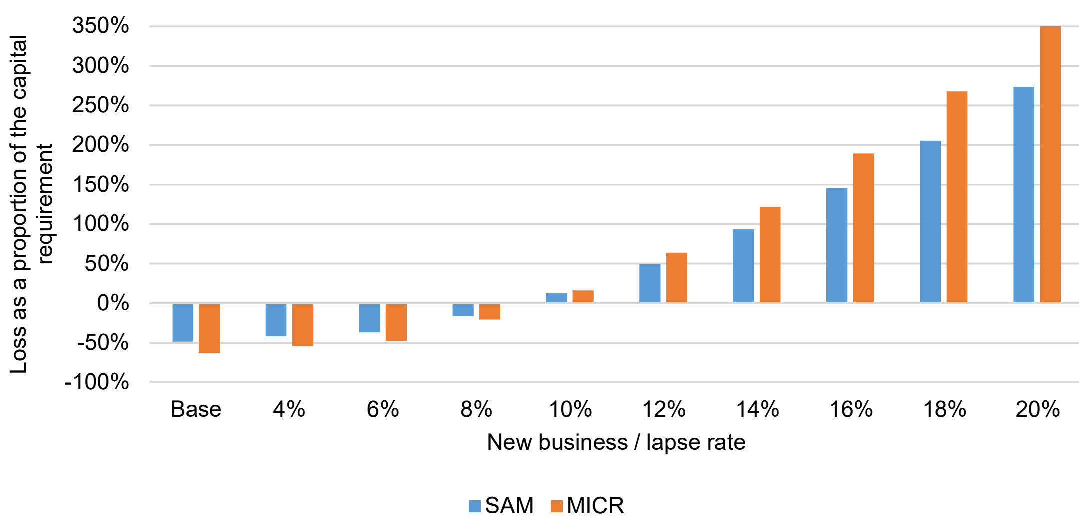

Figure 10.8: Microinsurer's loss as a proportion of the capital requirement for different combinations of lapse and new business rates

For each combination of lapse and new business rate, the microinsurers loss as a proportion of the capital requirement is shown. The microinsurer would be insolvent when the loss is 100% of the capital requirement. Figure 10.8 shows that this would occur when these rates were between 12% and 14% when the microinsurer holds the SCR and 14% to 16% when the microinsurer

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holds the MICR. Under the situation, the loss when the two variables change simultaneously exceeded the sum of the loss if they changed individually. For example, when both rates were 14%, the sum of the individual losses would equal 92% of the MICR whereas it would equal 122% of the MICR when they occur at the same time. This showed that the losses from high lapse and new business rates are amplified when they occur together.

10.3.3 Conclusion

The results of the various scenarios once again highlighted the risk to the microinsurer of charging inadequate premium rates. It also demonstrated how this risk can become much larger as the microinsurer is either growing rapidly or experiencing large amounts of lapses.

The scenarios also demonstrated how the size of the expense risk was dependent on the new business and lapse experiences of the microinsurer. On the other hand, the mortality risk was only indirectly related to these two movement rates. This meant that, given a certain level of new business or lapses, expense risk could become a larger concern than mortality risk.

The analysis in this chapter could only be used to assess the level of protection provided by the capital requirement in a subjective way (by checking which subjectively chosen combination of stresses led to insolvency). The capital requirements on the other hand specified a statistical level of protection and the outcome of such a subjective assessment cannot be compared to a statistical level of protection. A stochastic analysis could, however, be used to compare the level of statistical protection. This is discussed in the next chapter

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CHAPTER 11
STOCHASTIC TESTING OF THE CAPITAL ADEQUACY

11.1 INTRODUCTION

An advantage of a stochastic analysis is that it can be used to derive a statistical distribution of the results. This was important for this thesis since the regulatory capital requirement is based on a loss at the 99.5th percentile of the annual loss distribution of an insurer. This meant that a distribution of losses was required.

Specifying distributions, with confidence, for the various drivers of risk an insurer faces is not a straightforward exercise. There are three main reasons for this. The first is the lack of data with regards to many of the risks an insurer faces. An example of this lack of data was shown in the discussions with regards to SAM (Chapter 4) which resulted in many of the regulatory stresses being based on expert opinion which is, by definition, subjective. The second reason is the complexity of the risks due to the many real-world factors that influence the likelihood and severity of the risks. These factors are very difficult to capture in a statistical distribution. This also further exacerbates the data issues since the more variability there is in the outcome, the more data is required to model the risk accurately. The third reason is that what occurred in the past will not necessarily reflect the future. Thus, even if the derived distributions were perfect reflections of the risk in the past, they may not represent the future.

This of course does not apply to all risks equally as there is more data in some areas. An example of this would be market risk, where the financial crisis of 2008 provided a wealth of data. However, it is highly unlikely that the next financial crisis will be the same as the previous one and any fitted distribution would thus not be a perfect representation of the market risk an insurer faces in the future (SAM Steering Committee, 2014c: 6).

Two broad principles were followed to deal with these difficulties as well as the risk of spurious accuracy. The first was to limit the number of variables to which distributions were fitted. Frankland, Eshun, Hewitt, Jakhria, Jarvis, Rowe, Smith, Sharp, Sharpe and Wilkins (2014: 561) state the importance of limiting the scope of the risks modelled. Modelling too many risks can quickly make the modelling process impossible or highly spurious. They also, however, state the importance in recognising which risks have not been allowed for. These should still be quantified in some way, even if it is not based on statistical techniques

The variables excluded in this thesis were those that were of little significance to the model insurer or would be highly dependent on the insurer’s particular circumstances. An example of the former would be market risk. Since these are not significant, a quantification thereof was not deemed to be necessary. Examples of the latter type of risks include operational risk and premium rates

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which would depend on the operational structure of the insurer, the market they operate in and the attitudes of the management.

All of these are difficult to model for a particular insurer, let alone a generic insurer as was used in this thesis. However, it was still important to make some attempt at quantifying them. The risk of charging insufficient premiums has been dealt with extensively in the previous two chapters. Operational risk has not been quantified explicitly, but the impact of any operational risk event would likely come through in expenses. Thus, the expense distribution described later was assumed to capture both expense and operational risk.

The second principle was to use the more simplistic approach to specifying distributions if there was more than one possible approach. This was to avoid the spurious accuracy that can occur with specifying more complex distributions. This approach also helps with the data constraints related to fitting certain distributions. This principle is in line with the International Actuarial Association (2010: 9–11) proportionality principle in their notes on internal models.

Once the model had been calibrated, the results of the stochastic analysis provided a failure rate over a one-year period if the model microinsurer was holding the regulatory capital at the start of the year. If this failure rate was equal to 0.5% then the capital requirement would be sufficient to meet the requirement under SAM of withstanding a 1-in-200 year event. The results could thus be used to determine if the SAM SCR provided the specified level of protection for the model microinsurer. A similar comparison could be done for the MICR if it is assumed that it was also designed to survive a 1-in-200 year event.

However, the differences between the failure rate calculated in the model and the failure rate that the SCR and MICR were designed to meet did not imply that the author believed that SAM or the MICR was not necessarily correctly calibrated. Both the model used in this thesis and the SAM SCR and MICR rely on too many assumptions and approximations to make this conclusion. In addition, the SCR has been calibrated to provide the protection to the entire insurance industry on average and for all risks faced whereas this thesis had only looked at the major risks for funeral insurers.

The purpose of determining the failure rate was instead to provide some quantification to the weaknesses in the capital requirements highlighted in Chapter 9. To do this the failure rate was determined for some of the different microinsurers compared in that chapter. These included microinsurers:

- of different sizes;
- charging different premium rates; and
- with different claims experience.

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11.2 DESCRIPTION OF THE TEST

The variables modelled stochastically for the microinsurer were the mortality rates per age group (including an additional rate for catastrophes), expenses, the lapse rate and the new business rate. Sensitivity tests were performed on some of the distribution parameters to assess the reasonability of the parameters for the distributions which were calibrated with little or no data. These sensitivity test results are shown in Section 11.3.1.

11.2.1 Results that were determined

The distributions were used to simulate many different financial outcomes for the microinsurer over a one-year period (the 2018 financial year in the model). This was used to determine the level of protection provided by the capital requirement. To do this, the number of outcomes where the model microinsurer went insolvent (where the modelled loss exceeded the solvency capital held at the start of the year) during the year was determined and then divided by the number of outcomes generated. This insolvency rate was calculated for both the SAM and MICR by assuming the microinsurer held exactly the amount of capital required specified in each of the two regimes.

Next, a breakdown of the sources of insolvency was determined. This breakdown of the loss by risk provided additional insight into where the main risk of insolvency for the insurer arose. This breakdown was done by extracting the simulated scenario that resulted in the smallest loss which was in excess of the statutory capital i.e. in this scenario the insurer was just insolvent (this can be referred to as the 1-in-200 year scenario). For this 1-in-200 year scenario, the realisation of each simulated variable was extracted and then used as an input, one at a time, into the base model. The resultant change in profit or loss as a proportion of the total loss was the contribution to the loss of that particular variable.

Because each simulation is essentially a random outcome and several different combinations of risk could result in insolvency for the microinsurer, the simulated scenarios around the loss scenario were also extracted. A similar breakdown was provided for these. This provided a picture of the breakdown of the scenarios that resulted in losses of a similar magnitude to the 1-in-200 year scenario.

To determine the results described above, the distributions were specified in the Excel spreadsheet model using Palisade's @RISK software. The software can be used to specify distributions, and correlations between them, for various model inputs and then generate values from each distribution multiple times producing a distribution of outcomes. The outcome required for this test was the net profit before tax at the end of the financial year ending on December 2018.

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11.2.2 Simulation method used

The simulation method used by the @Risk software generates sample values from each distribution for each simulation run using the inverse transform method (Palisade Corporation, 2015: 788) . This method is described in Appendix C.1.

The software can be specified to use either the Monte Carlo or Latin Hypercube simulation method (Palisade Corporation, 2015: 789–792). The former simulates a random number between zero and one and then transforms this into a value from the chosen distribution using the inverse transform method. This is done for each specified distribution. Each simulated value is then used as an input which is used to derive the model output for that variable. The process is then repeated for the chosen number of simulations.

The Latin Hypercube method also uses the inverse transform method, but it divides the random number generated into equal intervals. For example, if there are ten intervals, a random number will first be simulated from the interval 0 to 0.1, 0.1 to 0.2 up until 0.9 to 1. Independence is maintained by randomly selecting the interval from which the variable is sampled (Kucherenko, Albrecht & Saltelli, 2015: 4–5). The random numbers generated are then transformed into the inputs for the simulation using the inverse transform method. The results of the simulations are then derived from the model for each input generated.

The Latin Hypercube approach was preferred since it ensures that low probability outcomes are allowed for in the output with fewer iterations than with Monte Carlo method which has the risk that the simulations are clustered around the higher probability events (Janssen, 2013: 125–126). This was an important aspect since assessing the adequacy of a capital requirement requires an assessment of low probability, high impact events.

To ensure that like for like comparisons were used when rerunning the simulations with different input assumptions, the initial seed used for the random number generator was kept the same for all simulations.

11.2.3 Specifying correlations

The distributions can also be specified so as to allow for correlations between the inputs. The software allows for the correlations by using the rank order or Spearman correlation coefficient which is based on rank values – the value's rank is based on its position if the values are ordered from smallest to largest. The software uses a two-step process to generate rank-correlated pairs of sample values. It first generates a set of randomly distributed rank scores for each variable using van der Waerden scores based on the inverse function of the normal distribution. The rank scores are then rearranged such that pairs of scores give the desired correlation coefficient. The second step is to generate the desired number of values from the distribution and then put them

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in ascending order. Then, for each variable, the nth smallest simulated value is used for the iteration with the nth smallest rank score (Palisade Corporation, 2015: 152–153).

11.2.4 Distributions used

The next sections will describe the distributions used in the model, the rationale for using them and how they were calibrated.

11.2.4.1 Mortality rates

The first variable considered was mortality risk. This risk generally comes in two forms for a microinsurer. The first was that the mortality experience of the lives assured by the microinsurer was worse than the insurer allowed for in the premium rates.

The second way that the risk could materialise was through a catastrophic event, such as a pandemic or natural disaster, that leads to a much larger number of deaths in the year, and by implication, many more claims.

To capture the first form of mortality risk, the mortality rates for each age group were fitted with a binomial distribution. This is a commonly used actuarial technique to model mortality rates (Konstantopoulos, 2006: 53). The cumulative distribution for a binomial distribution is shown in (11.1) which would be used to generate the claim numbers (Rizzo, 2008: 26).

$$F(x) = \sum_{j}^{x} \binom{n}{x} \times p^{j} \times (1-p)^{n-j}, x = 0,1,\dots,n \qquad (11.1)$$

where p is the probability of death for individuals in the age group

n is the number of lives assured in the age group

The distributions for each group were deemed to be highly, but not perfectly correlated. This was due to the mortality experience in each age group being affected by similar factors, for example the quality of healthcare. However, it would not be perfectly correlated as certain factors may only affect certain age groups, for example certain age groups may be more affected by new (non-catastrophe) diseases. Thus, the correlation parameters used between the distribution for each age group was 0.75*.

The number of additional deaths that arise out of the second source of risk, a catastrophe, were based on the simulation model built by Plantinga, Corubolo and Clover (2015). They modelled a

* The correlation parameters chosen in this chapter were roughly in line with the SAM approach shown in the FSB position papers. These were that parameters of 0, 0.25, 0.5, 0.75 and 1 were not, weakly, moderately, highly and perfectly correlated respectively (negative parameter values would follow the same pattern except that the variables would be negatively correlated).

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number of possible catastrophes by simulating both the frequency of each catastrophe type (or the likelihood of occurrence if the catastrophe can only happen once) and then simulating the associated number of deaths from each catastrophe.

The catastrophe risks that they considered were instantaneous events. Those considered were floods, earthquakes, tornadoes, industrial and mining accidents, road and rail accidents, commercial airliner accident and nuclear accidents. Non-instantaneous events, but also deemed catastrophic, were pandemics (Plantinga *et al.*, 2015: 58). The pandemic events that were modelled were influenza as the number of deaths from such pandemics far outweighed that of other pandemic risks (Plantinga *et al.*, 2015: 56)

Plantinga *et al*. (2015: 60) uses several compound distributions to determine the number of extra deaths per mille expected from a 1-in-200 year catastrophe event. Separate distributions were applied to each catastrophe type. The total number of catastrophe deaths was determined by aggregating the number of deaths simulated from each catastrophe event type. The 1-in-200 year shock calculated by Plantinga *et al.* (2015: 83–84) was 2.59 per mille. This shock was determined at a national level and thus it was assumed that the risk profile of the lives assured of the funeral insurer was the same as that of the total population.

The number of deaths from a catastrophe were allowed for in the model used in this thesis by resampling from the values simulated by the model of Plantinga *et al.* (2015). The additional number of deaths were then added to the number of deaths in June 2018 (the midpoint of the year).

The number of deaths from the catastrophe mortality risk and general mortality risks was not deemed to be independent by the SAM Steering Committee (2015: 6). They set the correlation coefficient between mortality risk and life catastrophe risk to 0.25, which implied a weak correlation between the two risks. The same correlation rate was used for the model microinsurer.

11.2.4.2 Expenses

Because of limited data, expense risk was modelled in a straightforward way. There was little to no information available on the possible shape of the insurer's expense distribution. Thus, a simplistic triangular distribution was used to capture the variance in the expenses. The distribution was used to model both the operating expense ratio and the acquisition cost per policy.

The distribution is based on the mode, the lower bound and the upper bound of the variable. The probability density function is shown in Figure 11.1 and cumulative probability function is shown in (11.2) (Johnson, 1997: 389) . This distribution was chosen as it allowed for a fair amount of

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variation, but still allowed for the fact that the assumed expense ratio* was the most likely outcome (as opposed to a uniform distribution where this would not be the case).

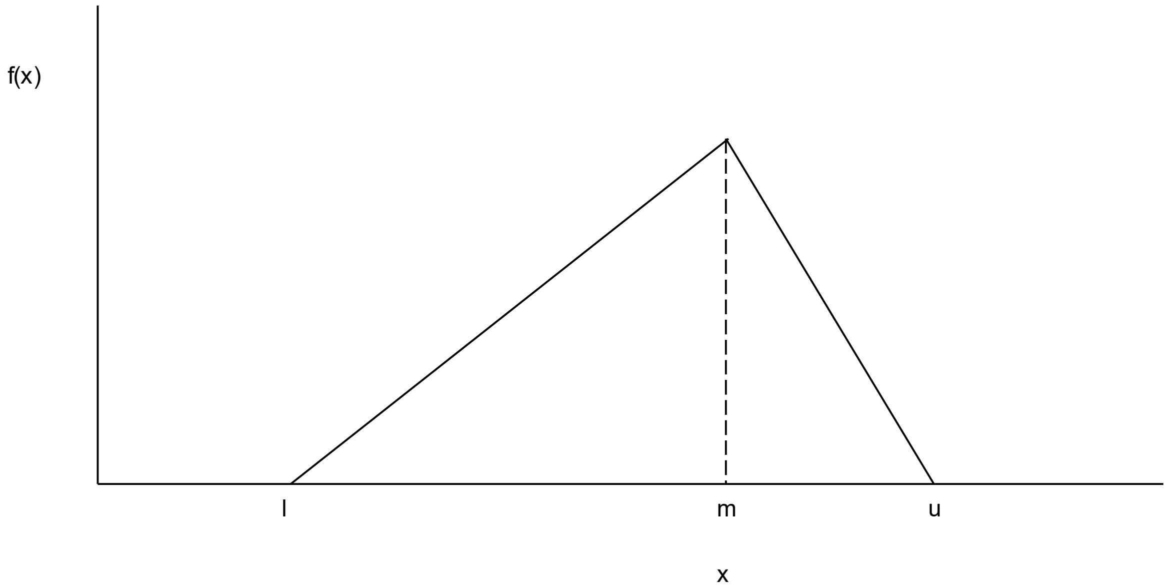

Figure 11.1: Probability density function of a triangular distribution

Source: Johnson, 1997: 389

$$F(x) = \begin{cases} \dfrac{(x^2 - l)}{(u - l) \times (m - l)};\ m \leq x \leq a \\ \dfrac{(u - x^2)}{(u - l) \times (u - m)};\ m \leq x \leq b \end{cases} \tag{11.2}$$

where l is the lower bound

u is the upper bound

m is the mode

To determine the appropriate bounds to the distribution, the variation in the LT returns were considered. The same insurers that were used to determine the most likely outcome in Section 8.4.5 were investigated. This showed that the operating ratio could vary between 20 and 30 percentage points (as a proportion of premium income) for an insurer over the period 2012 to

* While this value was derived as the mean of the statistics in the LT data, it was assumed that this data is symmetrical and that the mean derived was equal to the mode.

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2016. The variation between different insurers was greater still with the rates ranging from 5% to 70% of premium income.

It was decided to base the distribution on a variation of 30 percentage points. This meant that the lower bound of operating expenses was set to 10%, the upper bound to 40% and the mode was 25%. Similar ratios were applied to the acquisition cost per policy. It was to have a lower bound of approximately R30, an upper bound of R110 with the mode being R70 (this assumes a ± 60% proportional change in the value for the upper and lower bound which is the same as for the operating expenses).

A correlation parameter coefficient of 0.5 was specified between the two values as they were assumed to be moderately correlated since a failure to control expenses is likely to be a company-wide issue. The variables were assumed not to be perfectly or highly correlated as it was plausible that one department experiences expense issues whereas another department does not.

11.2.4.3 Lapse rates

Lapse risk, similar to mortality risk, also came in two forms. One was the gradual increase in lapses over the year. The second was in the form of a mass lapse in which many policyholders lapse suddenly. An example of such a mass lapse is where the insurer underwrites a group of policies for a large funeral parlour which then unexpectedly moves its business to a different insurer. Anecdotal evidence of this was attained from discussions with industry experts which singled this out as a substantial funeral insurance risk (Zondagh & du Tiot, 2017).

To capture the general lapse risk, a triangular distribution was used. This was, similar to the expense risk, due to the limited data available on the variation in the lapse rates. The parameters were then chosen in line with the minimum and maximum possible values, i.e. 0% for the lower bound and 100% for the upper bound. The mode was set to 19% which was the assumed lapse rate for the model microinsurer in 2018.

The upper bound of a 100% meant that all policies would have lapsed gradually over the year. This did not capture the mass lapse risk where many policyholders lapsed at once. Thus, a separate mass lapse scenario was modelled.

This risk was modelled using a compound distribution. The number of mass lapse scenarios in a year was modelled using a Poisson distribution. There was very little publicly available information on mass lapses to determine an appropriate parameter value for this distribution. Instead, a sensitivity test was performed using various expected values of the Poisson distribution (Lamda) which is shown in Section 11.3.1. Based on this, it was decided that assuming these scenarios were 1-in-10-year events was appropriate. For the severity of each mass lapse, it was assumed that this would vary uniformly between 25% and 50% of all lives assured.

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All the mass lapse scenarios were assumed to occur half way through the year. The model ensured that the total lapse rate did not exceed 100%. More details on the distributions used for the mass lapse scenario can be found in Appendix C.2.1.

This method assumed that the standard mass lapse rate and general lapse rates were independent. The validity of this assumption would depend on the reason for the mass lapse event. If it was due to a broker moving a book of business, then the assumption would seem reasonable. If it was due to reputational damage, then this assumption may be less likely to hold as reputational damage would affect both lapse types.

This approach also assumed that mortality rates and lapse rates were independent which is in line with the conclusion of the SAM Steering Committee (2015: 6).

11.2.4.4 New business rate

To specify the final distribution, for the new business rate, also proved difficult due to the limited data and the large number of factors that influence the new business rate. It was decided to use a triangular distribution for simplicity.

The LT ratio showed new business rates ranging from 0% to 70% (one outlier, growing at 800% was ignored). However, this range did not allow for the new business rate for group policies. To allow for this, the range of the distribution was expanded to a 100% new business rate, i.e. a doubling of business in-force.

It was also assumed that there would be a weak negative correlation between the lapse rates and new business. The correlation coefficient parameter was thus set to -0.25. This was based on the assumption that the microinsurer will likely have a good reputation if it is selling lots of new business and will should thus experience fewer lapses. However, the correlation was deemed to be weak as funeral policies are often lapsed due to circumstances of the individual policyholder as opposed to the reputation of the company. Lapses for this reason would thus be less likely to affect the selling of new business by the microinsurer.

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11.2.4.5 Summary of distributions used

Finally, the distributions used in the model are summarised in Table 11.1 for reference.

Table 11.1: Distributions applied to the major variables of the microinsurer

Risk	**Distribution used**	**Parameters used**
General mortality risk	Binomial distribution, separately applied to each age group	The probability parameter, p, is the mortality rate for the group
Catastrophe risk	Catastrophe model developed by Plantinga, Corubolo and Clover (2015)	Various compound distributions
Expense risk	Triangular distribution	Upper bound of 40% of premium income, lower bound of 10% and the mode of 25%
Lapse risk	Triangular distribution	Upper bound of 100%, lower bound of 0% and the mode of 19%
Mass lapse	Compound distribution with a Poisson frequency and uniform severity	Lambda for the Poisson distribution is 0.1 and the uniform upper and lower bound are 50% and 25% respectively
New business risk	Triangular distribution	Upper bound of 100%, lower bound of 0% and the mode of 30%%

11.3 THE MODEL MICORINSURER RESULTS

With the distributions now specified, the model could produce the required results. The insolvency rate for the base microinsurer was 0.12% and 0.19% under SAM and the MICR respectively. Thus the 10% difference between the SAM SCR and MICR, as shown in Section 9.2.1, translated into a fairly small difference in insolvency risk. Both requirements also result in insolvency rates of less than 0.5% as required by SAM. Thus, for the model microinsurer, both capital requirements provided sufficient protection. The level of protection was also fairly similar.

These results do, however, depend on the parameter distributions. Sensitivity tests were performed on the distribution parameters to determine how sensitive the outcomes were to the parameters. This helped in assessing the reliability of the results.

11.3.1 Sensitivity of the results to the parameters

The sensitivity tests were performed on the parameters where the distributions were most uncertain due to a lack of data. This was with regards to the expenses, the lapses and the new business rate.

The expense sensitivity test was performed by varying the upper and lower bound for the acquisition and operation expenses in the same proportion. The results are shown in Table 11.2 with the grey shaded row representing the chosen distribution parameters. The insolvency rate proved to be somewhat sensitive to the choice of expense parameters.

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Table 11.2: Impact on the insolvency rate for different expense distribution parameters

Operating expense ratio		Acquisition cost (R per policy)		Insolvency rate	
Lower bound*	Upper bound	Lower bound†	Upper bound	SAM	Micro
20%	30%	54	80	0.00%	0.01%
15%	35%	40	94	0.01%	0.04%
10%	40%	27	107	0.12%	0.19%
5%	45%	13	121	0.94%	1.62%
5%	50%	13	134	4.12%	5.93%

The next test was with regards to the upper bound for the lapse rate distribution (the lower bound was kept at zero). The results, shown in Table 11.3, showed that the distribution was not very sensitive to a change in this variable value so the intuitive choice of upper bound seemed acceptable. The grey shaded value represented the chosen distribution parameter.

Table 11.3: Impact on the insolvency rate for different lapse rate parameters

Upper bound	SAM insolvency rate	Micro insolvency rate
25%	0.06%	0.10%
50%	0.06%	0.13%
75%	0.08%	0.16%
100%	0.12%	0.19%

Table 11.4: Impact on the insolvency rate for different Lambda values

Lamda	SAM insolvency rate	Micro insolvency rate
5%	0.07%	0.13%
10%	0.12%	0.19%
15%	0.20%	0.32%
20%	0.27%	0.44%
25%	0.38%	0.64%
50%	1.34%	2.10%
100%	4.91%	6.91%

The next lapse sensitivity was to vary the Lambda parameter of the mass lapse scenario. The results were more sensitive to changes in this value than the lapse upper bound. It was however difficult to determine an appropriate Lambda value without more information. Assuming it was a 1-in-20-year (5%) event seemed too low whereas a 1-in-2-year (50%) event seemed too extreme.

* The lower bound was limited to 5% since a 0% expense assumption did not seem reasonable.
† The lower bound was limited to R13 per policy as an assumption of R0 did not seem reasonable.

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On the other hand, either a 1-in-10 year (10%) or a 1-in-5 year (20%) event seemed reasonable. Since the difference between these two was not that significant, a 1-in-10-year assumption seemed acceptable.

The upper bound of the new business rate distribution was also investigated. The results were very sensitive to the choice in upper bound. However, the largest upper bound tested implied that business would quadruple in size which would place a significant amount of pressure on the microinsurer's expenses. Thus, the large insolvency rate associated with the largest upper bound did not seem unreasonable. Again, with limited data available, the assumption of a 100% new business rate as upper bound was deemed appropriate.

Table 11.5: Impact on the insolvency rate for different new business rates

Upper bound	SAM insolvency rate	Micro insolvency rate
50%	0.12%	0.16%
100%	0.12%	0.19%
150%	0.68%	1.08%
200%	3.37%	4.49%
250%	9.04%	10.59%
300%	17.46%	19.15%

The last test was with regards to the correlation factors chosen. It was found that changing these values had a very small effect on the results.

11.3.2 Breakdown of the sources of loss

With the sensitivity of the results to the parameter inputs known, the next step was to derive the driving factors of insolvency for the microinsurer. This was done by looking at the contribution of each factor to the loss under the simulated scenario (and the surrounding scenarios) that led to insolvency as described in Section 11.2.1.

The breakdown of the loss for 30 of the simulated scenarios is shown in Table 11.6. The 30 scenarios shown were those that resulted in the 10th to 40th largest simulated losses. The one corresponding with insolvency for SAM was the 12th largest loss and the 19Th largest loss corresponded with insolvency under the MICR (these are highlighted in grey).

The results showed that the mortality risk made up a fairly small portion of the simulated loss events. It varied from making up 10% of the loss to decreasing the total loss by 10% (i.e. the mortality rates were better than expected). This meant that the mortality risk made up a smaller portion of the total loss than would be expected under SAM where the mortality risk made up 35% of the SCR.

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This was largely because neither the SAM SCR nor the MICR appeared to allow for the diversification benefit of assuring more lives. This diversification benefit arises due to the law of large numbers: the more lives assured, the lower the variation in the claims rate. With the model microinsurer assuring 300 000 lives, there was little variation in the claims rate.

Table 11.6: Breakdown of the insolvency loss scenarios

Loss event rank	Mortality	Cata- -strophe	Expenses	Lapses	Mass Lapse	New business
10	4.3%	24.1%	70.5%	-1.7%	0.0%	2.8%
11	8.0%	0.0%	22.6%	-5.9%	71.6%	3.7%
12	6.2%	0.0%	64.9%	-12.4%	35.6%	5.6%
13	4.7%	0.0%	65.8%	-8.2%	41.4%	-3.7%
14	3.8%	0.0%	74.4%	-12.7%	31.6%	2.9%
15	10.7%	0.1%	77.6%	-0.6%	0.0%	12.2%
16	-4.9%	0.1%	52.8%	-10.1%	78.0%	-15.8%
17	4.1%	0.0%	79.4%	-14.4%	0.0%	30.9%
18	7.5%	0.0%	73.1%	-13.0%	0.0%	32.4%
19	-1.0%	0.0%	67.6%	5.2%	0.0%	28.1%
20	0.8%	0.0%	73.5%	-12.4%	0.0%	38.1%
21	8.8%	0.0%	75.3%	-5.2%	0.0%	21.2%
22	2.2%	0.0%	69.2%	-12.7%	0.0%	41.2%
23	9.2%	0.0%	46.4%	7.4%	37.8%	-0.8%
24	-2.3%	0.0%	50.4%	4.5%	41.7%	5.8%
25	1.4%	29.0%	63.7%	-1.4%	0.0%	7.3%
26	9.8%	18.3%	66.1%	-2.1%	0.0%	7.9%
27	6.3%	0.0%	68.3%	-13.6%	0.0%	39.0%
28	4.2%	12.0%	30.8%	1.7%	58.5%	-7.2%
29	-2.2%	0.0%	65.9%	-7.9%	42.0%	2.1%
30	5.6%	29.3%	46.5%	-4.1%	0.0%	22.8%
31	4.6%	0.0%	66.5%	7.6%	0.0%	21.3%
32	4.8%	0.0%	64.1%	-13.1%	0.0%	44.2%
33	-1.5%	0.0%	75.7%	-12.3%	0.0%	38.1%
34	5.3%	0.0%	62.2%	-8.6%	0.0%	41.1%
35	3.6%	0.0%	73.2%	-0.3%	25.4%	-2.0%
36	2.9%	0.1%	42.2%	12.0%	41.7%	1.2%
37	-5.7%	31.3%	58.9%	-12.3%	0.0%	27.8%
38	3.7%	0.0%	47.5%	-5.4%	47.5%	6.7%
39	7.1%	0.0%	79.1%	9.4%	0.0%	4.3%
40	-9.2%	0.0%	33.6%	0.3%	87.8%	-12.4%

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However, there would be no such diversification benefit when it came to life catastrophe risk. A catastrophe event would affect many assured lives and thus the risk would no longer be independent. This meant that the law of large numbers would not apply.

In the simulated scenarios that contained catastrophe events, the loss made up between 10% and 30% of the total loss. This is roughly in line with the life catastrophe risk module in SAM which made up 23% of the SCR.

Expense risk, on the other hand contributed a significant part of the total losses for the microinsurer. Its contribution varied between 30% and 80%. On average the contribution was about 60% which is significantly larger than the 20% that would be expected under SAM. However, if expense risk is bundled with operational risk, then it would make up 35% of the SAM SCR. This is closer to the proportion observed in the model, but still lower.

The risk from lapses arose mostly from the mass lapse scenarios. There were 13 scenarios that contained a mass lapse event. The contribution of the mass lapse varied from 25% to nearly 90% of the total loss from the simulated scenarios, given that a mass lapse occurred. This result implied that excluding the lapse risk module from the SCR due to the short contract boundary (as discussed in Section 0) may be inappropriate. This conclusion is however, based on the assumption that the model was a fair representation of a funeral insurer's risks.

An additional caveat to this conclusion is that an insurer going insolvent after a mass lapse event may not necessarily be a policyholder risk as discussed in Section 10.2.2.2.

The general lapse rate made a smaller contribution to the losses in the simulated scenarios. It also decreased the loss in many of the simulated scenarios. This seemed sensible if the scenario in Figure 10.7 is considered where both lapses and expenses were stressed[*]. Under this scenario the microinsurer's losses decreased as the monthly lapse rate increased to 8% and thereafter losses increased. The distribution for general lapses would not result in a monthly lapse rate that exceeded 8% which is why it contributed such a small part of the total loss. On the other hand, the lapse rate in a single month would be much larger than 8% if the mass lapse event occurred which is why it made such a large contribution to the total loss.

The final part that contributed to the loss in the simulations was the new business rate. Its contribution to the loss per simulated scenario varied from -15% to 45%. The scenarios in which it contributed a large portion of the total loss were also scenarios in which the simulated expenses were also large relative to the base value. Thus, the loss from this variable was also mostly due to the expenses.

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[*] This scenario was a sensible comparison since the driver of the losses in the simulation was the expenses.

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The insolvency risk for the base microinsurer was thus mostly driven by the expense risk. This was however mostly due to the microinsurer being very large and experiencing very limited amounts of variation in its claims. The first scenario considered below in Section 11.4.1 shows how this situation changes when the microinsurer is much smaller.

11.4 RESULTS FOR DIFFERENT TYPES OF MICROINSURERS

The final set of results looked at how the insolvency rate changed for different types of microinsurers. The first scenario looked at microinsurers of different sizes. The purpose of this analysis was to determine the impact on the insolvency rate when the microinsurer had fewer policyholders. As discussed in the previous section, the mortality rate did not have a significant impact on the risk of insolvency due to the law of large numbers.

The remaining sections will look at the how the weaknesses of the capital requirement highlighted in Chapter 9 impact the microinsurer's insolvency rate. This will be done by determining the insolvency rate for some of the different types of microinsurers covered in Chapter 9.

11.4.1 Microinsurers of different sizes

The insolvency rate for the microinsurers with different numbers of lives assured is shown in Figure 11.2. The insolvency rates have been calculated by ignoring the absolute minimum capital requirement. The figure shows a rapid deterioration for microinsurers with less the 10 000 lives assured. The 0.5% insolvency rate is reached for a microinsurer with 25 000 lives assured for the SCR and 45 000 for the SAM SCR.

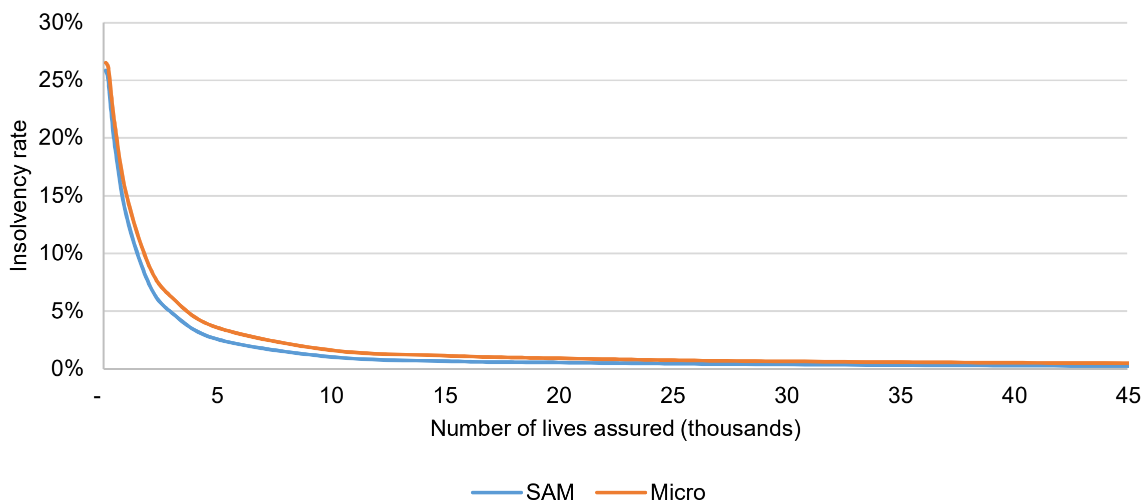

Figure 11.2: Insolvency rates for microinsurers with different numbers of lives assured

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These results would be concerning, since it is assumed that the simplified MICR is aimed at small insurers of possibly less than 10 000 lives assured. However, once the absolute minimum capital requirement this is allowed for in the calculation, the insolvency rate does not exceed 0.5% regardless of the numbers of lives assured. Hence the capital floor removed the risk of having too few lives assured. It thus served the purpose as discussed in Section 3.4.3, namely to ensure the microinsurer has a sustainable risk pool.

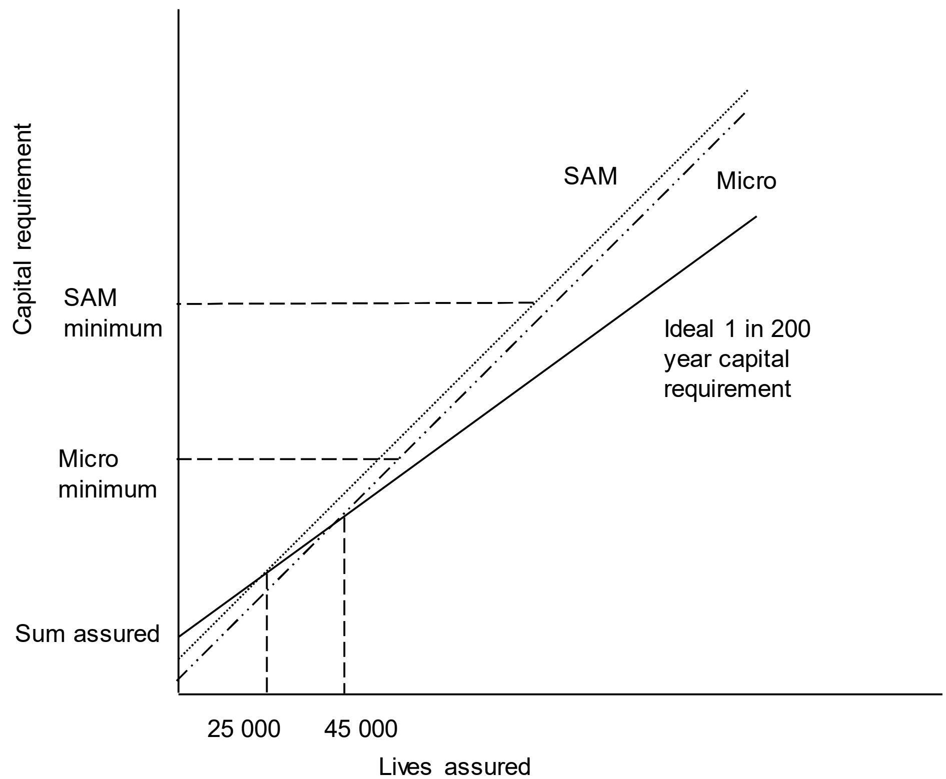

Figure 11.3: Ideal capital requirement vs the SAM and proposed microinsurance capital requirements

Figure 11.3 provides a simple conceptual illustration of how the capital floor achieves the goal of ensuring that the microinsurer has a sufficiently large risk pool. Assume that there is some ideal capital requirement that will always result in a 0.5% insolvency rate over a one-year period, represented by the solid line in the figure. This ideal will differ as the number of lives assured differ. It will start with only the full sum-at-risk being sufficient to protect against a 1-in-200 year event. As more lives are added, the capital requirement will decrease as a proportion of the sum-

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at-risk due to diversification. Thus, this line is less than 45 degrees as less than the sum-at-risk for each new policy need to be added*.

It is unlikely that any regulatory capital requirement will be able to replicate this ideal capital requirement. Instead, a regulator would want a requirement that is close to the ideal, but always greater than it.

No matching the regulatory capital requirement is thus likely to have the same gradient† as the ideal requirement. Thus, there will likely be a point of intersection between the two capital requirements. At this point of intersection, the regulatory capital requirement will exceed the ideal if more lives assured are added, i.e. moving right along the x-axis in the figure. The regulator will thus want the absolute minimum capital requirement to exceed the point of intersection such that the regulatory capital requirement will always exceed the ideal.

This point of intersection in the model occurred approximately where 25 000 lives are assured under the SCR, shown as the round dotted line, and 45 000 under the MICR, shown as the dash and dotted line. The absolute minimum capital requirement under both solvency regimes, shown by the dashed lines, exceeded the point of intersection in this thesis.

However, it would appear that these absolute minimums may have been set at a higher value than would be required. The point where the percentage of premiums component of the MICR provides less than 0.5% corresponds with a capital requirement of roughly R3 million. Thus, it would appear as if the old absolute minimum may have been more appropriate – again, assumed the model used in this thesis is a reasonable approximation for a real insurer.

However, the discussion in Section 5.6 showed that even at R3 million this requirement was still likely too high to help very small insurers to formalise. A more appropriate manner may be to provide a capital requirement that better approximates the ideal 1-in-200 year capital requirement so that the absolute minimum can be set to a lower level.

A capital requirement which increased on a per policyholder basis as the number of lives assured may provide a better approximation of the ideal. This is because the main driver in the high insolvency rate seen for small microinsurers was because the MICR did not allow for the loss of diversification benefits from assuring fewer lives. A capital requirement that changes per life assured based on total the number of lives assured could allow for the change in diversification

* The ideal capital requirement may change gradient as the number of lives assured changes, and hence it would not represent a straight line. However, for the purpose of this simple explanation the line is assumed to be straight.

† Or shape if a more complex example is considered with changing gradients.

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benefits if it is set up correctly. Determining such a requirement was however beyond the scope of this thesis and may be suitable for future research.

With regards to the SAM requirement, the actual absolute minimum of R15 million was significantly larger than the capital requirement that corresponded with a 0.5% insolvency rate. This absolute minimum was however designed to be appropriate for a wide variety of insurance business types, some of which are much more complex than that of funeral insurance. Thus, the appropriateness of this minimum could not be inferred from the results of the model.

11.4.2 Microinsurers charging different premium rates

The next situation investigated was the impact on the insolvency rate of a microinsurer charging different premium rates. This was done by changing the premium rates in the model for both 2017 and 2018 and recalculating the insolvency rate over 2018. All other assumptions were kept the same as those used for the model microinsurer.

The results are shown in Figure 11.4. The insolvency rate increase as premiums decreased was more pronounced under the MICR than the SAM SCR. This was because in the case of the MICR, the microinsurer was not only making less profit and thus more vulnerable to loss, but was also required to hold a smaller capital requirement since the capital requirement was now based on smaller amount of premium income.

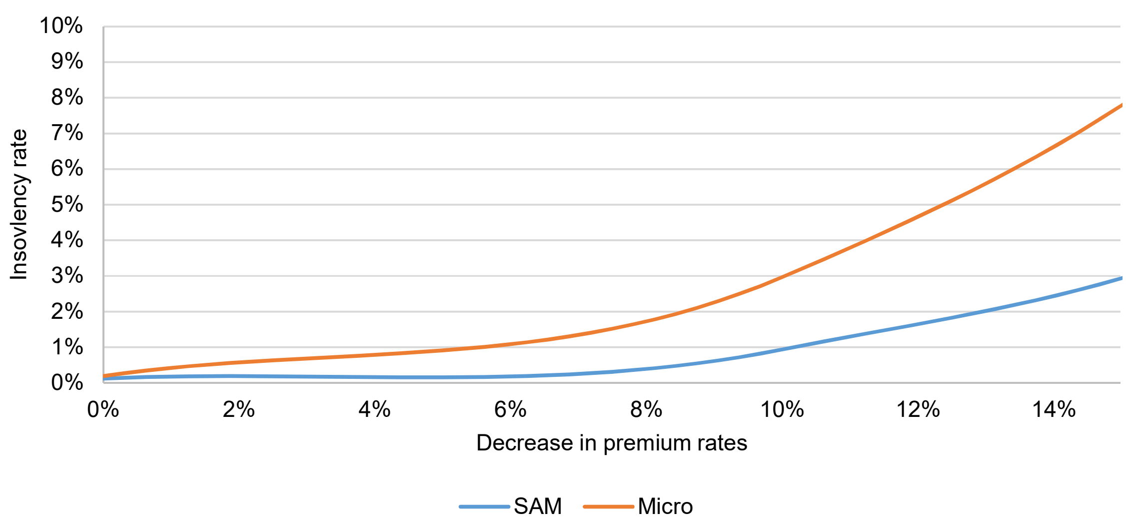

Figure 11.4: Impact of different premium rates on the insolvency rate

A good point of reference for quantifying the impact on the insolvency rate of charging lower premiums was the point at which the insurer would break even – after about a 9% reduction in premiums. The insolvency rate at this point increased to approximately 2.9% and 0.9% under the

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MICR and the SCR respectively. This weakness thus does appear to have a fairly significant impact of the insolvency rate of a microinsurer that is decreasing its premium rates.

11.4.3 Microinsurers with different mortality experience

The next situation investigated was the impact on the insolvency rate of a microinsurer experiencing different mortality rates. This was done by changing the base mortality rates in the model for both 2017 and 2018 and recalculating the insolvency rate over 2018. All other assumptions were kept the same as those used for the model microinsurer.

Figure 11.5 shows the results. The insolvency increase as the mortality rates increase is less pronounced when the microinsurer is holding the SAM SCR as opposed to the MICR. This reflects the extra protection provided by the mortality risk module which would require a microinsurer to hold additional capital as mortality rates increase.

Again, a good point of reference for quantifying the impact on the insolvency rate of higher claims rates and thus lower profits is where the profits are reduced to zero – this occurs after approximately a 15% increase in claim rates. The insolvency rate at this point increased to approximately 4.0% and 1.5% under the MICR and the SCR respectively. The fact that the MICR does not explicitly allow for mortality risk thus appears to have a fairly significant impact of the insolvency rate of a microinsurer experiencing higher claims.

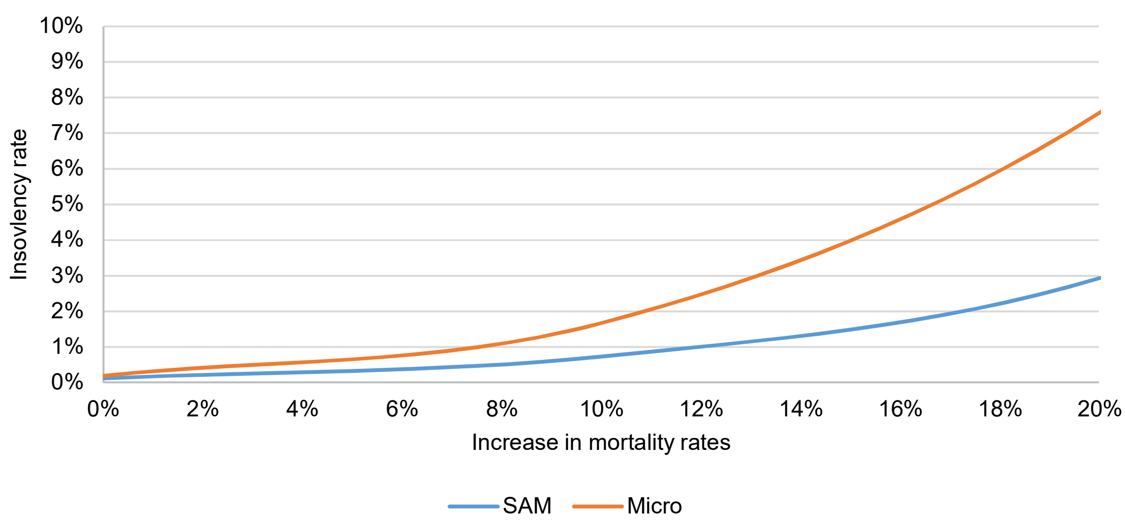

Figure 11.5: Impact of different mortality experience on the insolvency rate

11.5 SUMMARY

This results in this chapter showed that, as with the nominal values of the capital requirements, the level of protection under the MICR and SCR for the model microinsurer did not differ that

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significantly. It showed that the largest risks identified for the model microinsurer were expenses, mass lapse and catastrophe. This should thus be an important consideration for any microinsurer that chooses the simplified approach, where these risks are not explicitly allowed for as under SAM.

The results also showed that the number of lives assured also has a large impact on the insolvency risk of a microinsurer, but that the absolute minimum requirements largely eliminate this risk. A further finding was that this absolute minimum was likely to be slightly overstated for the MICR, but not significantly so. This meant that the MICR in its current form was unlikely to encourage much formalisation since this absolute minimum would likely be too high relative to the premium income earned.

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CHAPTER 12
SUMMARY, CONCLUSION AND RECOMMENDATIONS

12.1 INTRODUCTION

This chapters gives a summary of the main findings of the thesis. This includes the results of the comparisons performed between the capital requirements and the various adequacy tests performed. It concludes with a discussion of possible topics for future research.

12.2 SUMMARY OF MAIN FINDINGS

The main finding of this thesis was that for the model microinsurer – which was designed to represent an average funeral insurer in South Africa – the MICR proved to be a good approximation of the SCR. Whist the difference in nominal terms between the requirements was about 10%, the difference between the insolvency rates was not that significant. Further, both capital requirements resulted in an insolvency rate of less than 0.5% as is required by SAM.

The results also showed that the approximation proved to be less suitable when a microinsurer's risk increased relative to the model microinsurer. The situation where this was most apparent was for a microinsurer charging premium rates that were not adequate to cover its outgo. In such situations, the MICR performed very poorly as a capital requirement. This was because it decreased as the premium rate decreased which meant that as the risk of the microinsurer went up, the capital requirement went down. The consequence of this was that the microinsurer could be exposed to a fairly significant insolvency rate of 2.9% (under the MICR compared to 0.9% under the SCR) where the premium rates decreased to the extent that the microinsurer had a zero expected profit margin.

In general, the SAM SCR proved to be more risk sensitive than the MCIR as would be expected. This was shown in the scenario where the microinsurer experienced higher mortality rates. The SAM SCR increased to reflect this greater risk whereas the MICR did not. This resulted in the model microinsurer experiencing a much larger insolvency rate of 4.0% under the MICR versus 1.5% under SAM when the claims rate had increased to the point that the microinsurer was making no profit.

There were also scenarios where both capital requirements performed poorly. This was mostly in scenarios of extreme policyholder movement. Neither capital requirement allowed for the additional risk a microinsurer would face when it was growing rapidly. Such scenarios would require careful monitoring from both the regulator and the microinsurer's management.

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It was also shown that whether the capital requirements are compared over a one- or ten- year period, the results were very similar. This seemed to indicate that there was no significant risk that would be missed as a result of the capital requirements only being based on a one-year period.

The results also suggested that the absolute minimum capital requirement for the MICR may be larger than necessary. This may provide some support for reducing the absolute minimum requirement. However, even after this reduction, the capital requirement is likely to still be too onerous for most informal microinsurers to be encouraged to formalise based on the research done by CENFRI (see Section 5.6).

Thus, while the MICR is, for the most part, a good approximation for the SCR and is less onerous for microinsurers, it seems unlikely that it will achieve one of its objectives in its current form: to encourage small microinsurers to formalise.

12.3 FURTHER RESEARCH

To expand on the research done in this thesis, it would be useful to provide a similar comparison for other types of microinsurance products available in the South African market. Of particular interest are credit life products which also make up a large portion of the market.

Research should also be done into possible tweaks to the MICR such that the absolute minimum can be lowered. The simplest approach will likely be to make the capital requirement a function of the number of policies written. These adjustments should ideally assist in lowering the barriers to entry into this market and thus encourage formalisation.

Further research could also be done into the appropriateness of the simulation methods and statistical distributions used in this thesis and how to improve on them. For example, research could be done into how to model and choose distributions for risks where there is very limited data. This will assist with refining the solvency capital comparison framework described in this thesis which could be used by future researchers as a basis of comparison.

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APPENDIX A:
MODEL INPUTS AND ASSUMPTIONS

A.1. CQS FACTORS

The $factor_i$ corresponding to each CQS used in (4.9) is shown in Table A.1 and the value of g_i used for each CQS in (4.11) is shown in Table A.2.

Table A.1: Default factor corresponding to each CQS

CQS	Default risk factor
1	0.10%
2	0.19%
3	0.27%
4	0.49%
5	0.68%
6	0.80%
7	1.08%
8	1.37%
9	2.06%
10	2.56%
11	3.27%
12	4.35%
13	5.68%
14	7.96%
15	10.10%
16	14.47%
17	15.38%
18	15.86%

Source: PA, 2018b: 24

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Table A.2: Threshold factor for each counterparty CQS

CQS of counterparty	Threshold factor (*g*)
1 to 6	0.12
7	0.19
8	0.27
9	0.36
10	0.45
11	0.53
13	0.58
14	0.61
15	0.63
16	0.66
17	0.68
18	0.71
Unrated	0.73

Source: PA, 2018b: 26–27

A.2. MODEL MORTALITY RATES

Table A.3 shows the mortality rates used in the model for each age band between 2016 and 2020.

Table A.3: Model mortality rates per age band for selected years

Age bands	Mortality rate per mille in each selected modelled year				
	2016	**2017**	**2018**	**2019**	**2020**
18-19	1.73	1.76	1.79	1.79	1.76
20-24	2.79	2.80	2.79	2.75	2.68
25-34	5.79	5.91	6.02	5.81	5.34
35-44	9.39	9.74	10.13	9.99	9.28
45-49	11.75	12.09	12.49	12.37	11.74
50-54	14.17	14.38	14.66	14.49	13.90
55-64	20.09	20.15	20.23	20.00	19.48
65-84	56.11	56.05	55.99	55.88	55.70

Source: Johnson *et al.*, 2016

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A.3. LT EXPENSE RATIO FOR SELECTED INSURERS

The operating expense and acquisition cost ratios for insurers writing more than 70% assistance business, as determined from the Long-Term Insurance Registrar's reports, is shown in Table A.4 and Table A.5 respectively for the years 2012 to 2016. A grey entry indicates that the insurer wrote less than 70% assistance business in that year.

Table A.4: Operating expense ratios for insurers writing more than 70% assistance business

Insurer	2012	2013	2014	2015	2016
Bophelo Life				0.0%	0.0%
Constantia Life and Health	34.9%	45.2%	50.0%		
Constantia Life Limited	7.6%	6.9%	21.3%	26.7%	43.7%
Covision Life	3.4%		0.0%		
KGA Life	30.2%	36.6%	36.7%	32.3%	27.1%
Lion Life			27.1%	31.6%	
Nest Life	38.0%				
Safrican	11.8%				
Smart Life			0.0%		21.2%
Union Life	0.0%	0.0%	20.5%	5.9%	6.2%
Workers life	0.0%	0.0%	61.0%	67.6%	63.9%

Source: Insurance Division, 2013, 2014, 2015, 2016, 2017b

Table A.5: Acquisition cost ratios for insurers writing more than 70% assistance business

Insurer	2012	2013	2014	2015	2016
Bophelo Life				35.4%	96.7%
Constantia Life and Health	5.1%	4.1%	2.6%		
Constantia Life Limited	91.1%	51.2%	38.6%	27.2%	12.0%
Covision Life	75.9%		74.9%		
KGA Life	21.5%	19.8%	20.8%	21.0%	20.4%
Lion Life			39.6%	46.2%	
Nest Life	21.4%				
Safrican	16.5%				
Smart Life			125.1%		36.1%
Union Life	43.9%	48.0%	27.1%	39.4%	40.2%
Workers life	13.1%	19.2%	9.1%	12.1%	10.9%

Source: Insurance Division, 2013, 2014, 2015, 2016, 2017b

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A.4. POLICYHOLDER MOVEMENTS METHODOLOGY

Table A.6 illustrates how the movement rate calculation works. For cohort year one, 100 new policies are assumed to be sold at the start of the year. In cohort year two, the same number of policies, increased by the new business growth rate, are sold resulting in the 105. This is then repeated for all the cohort years. The new business rate in each calendar year is then the number of policies sold in that year divided by the total in force at the start.

Each cohort is then assumed to lapse based on the durational lapse assumption. The runoff of each cohort is shown in the table. The lapse rate in each calendar year is then the sum of the lapses that have occurred at the end of the calendar year divided by the number of policies in force at the start of the calendar year.

Table A.6: Illustrative example of the movement rate calculation methodology

Calendar year	In force policies for each cohort year at the start of the calendar year						Total in force	Lapse rate	New business rate
	1	2	3	4	5	6			
1	100.00						100.00	36.5%	100.0%
2	63.50	105.00					168.50	29.7%	62.3%
3	51.75	66.68	110.25				228.68	25.7%	48.2%
4	45.54	54.34	70.01	115.76			285.65	22.8%	40.5%
5	42.13	47.82	57.06	73.51	121.55		342.06	20.9%	35.5%
6	38.97	44.23	50.21	59.91	77.18	127.63	398.13	19.6%	32.1%

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APPENDIX B:
ADDITIONAL DETERMINSITC RESULTS

B.1. ONE YEAR COMPARISON OF THE CAPITAL REQUIREMENTS

B.1.1. Impact on the SCR of a change in premium rates for a microinsurer growing at different rates

See discussion in Section 9.2.5.2 for more details of the comparisons performed.

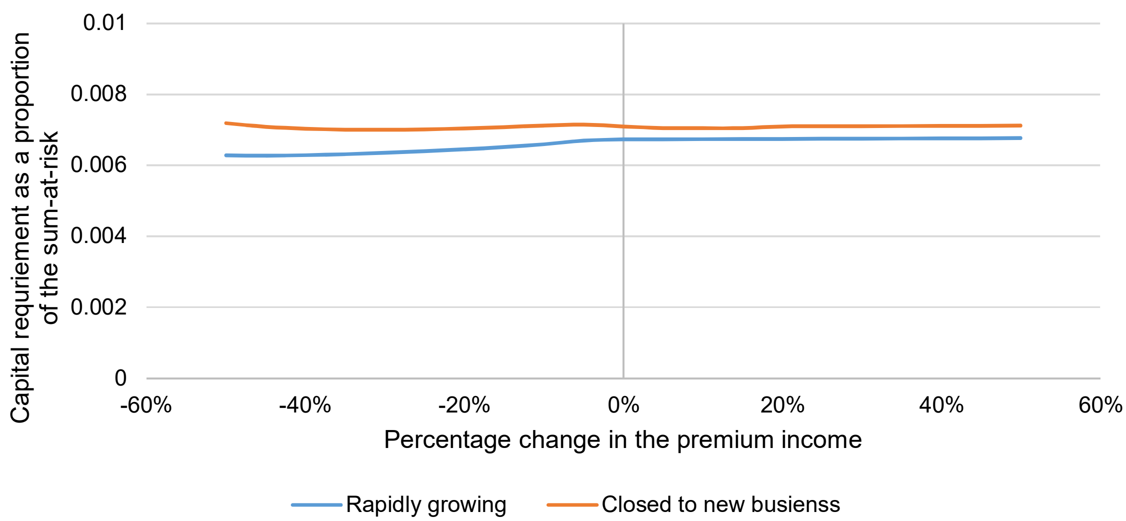

Figure B.1: Impact of charging a different premium rate of a microinsurer with different growth rates

B.1.2. Microinsurers of different sizes

Figure B.2 shows the SCR and MICR for the model microinsurer assuming different number of policies in-force as at 31 December 2017.

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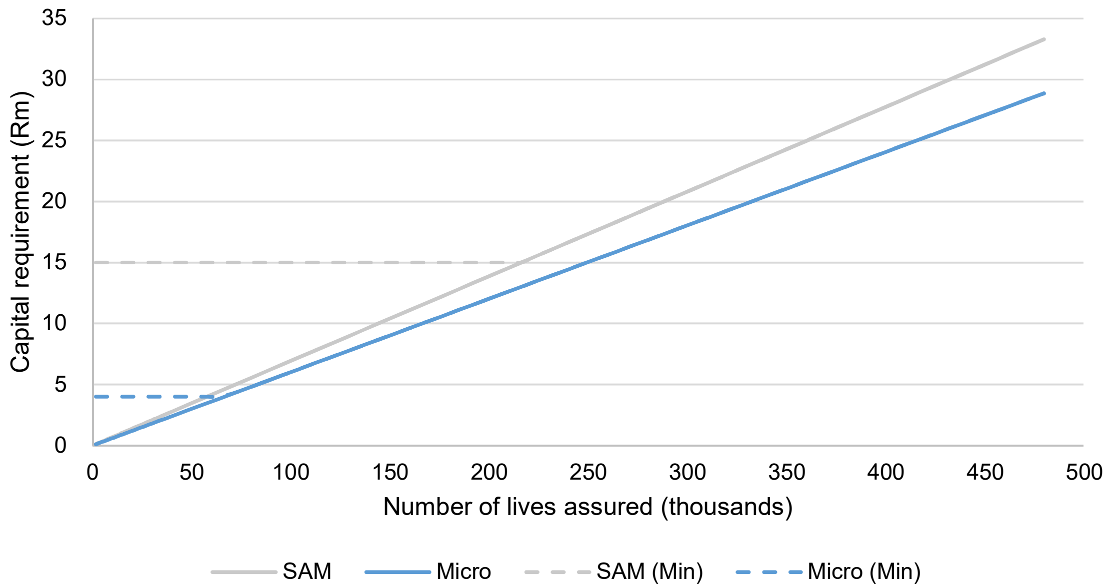

Figure B.2: Nominal capital value for different numbers of lives assured for the model microinsurer

B.2. TEN YEAR COMPARISON OF THE CAPITAL REQUIREMENTS

B.2.1. Microinsurers charging different premium rates

The comparisons performed in Section 9.2.2 was also reperformed over a ten-year period. The situation remained the same over the long-term. A lower premium rate charged, which resulted in a lower profit margin, meant that the insurer was more vulnerable to loss. Under this scenario the SAM SCR increases whereas the MICR decreases.

B.2.2. Microinsurers with different mortality and lapse experience

As in the previous section, comparisons for microinsurers with different lapse and mortality experiences were also investigated over a ten-year period. The same points that were noted in Section 9.2.3 and 9.2.4 also applied when performing the comparison over a longer time period.

B.2.3. Microinsurer growing at different rates

Similar to Section 9.2.5, comparisons were performed to see how the two capital requirements compared for microinsurers growing at different rates over a ten-year period.

Figure B.3 shows the two capital requirements as a proportion of the sum-at-risk for a rapidly growing microinsurer. As with the model microinsurer, the SAM SCR initially exceeds the MICR at the start of the period whereas the reverse is the case at the end of the period. The point of the

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inversion is however after a later period of time – at year nine as opposed to year seven for the base microinsurer.

In contrast, for the microinsurer closed to new business the point of inversion was earlier than for the model microinsurer Figure B.4 shows that this point is after six years.

The reason for this was the similar to the explanation provided in Section 9.2.5. at the end of any given year, both the MICR and the SAM SCR would be understated for a rapidly growing microinsurer and overstated for a shrinking microinsurer. This was due to the capital requirement being based on the average number of lives assured over the year as opposed to the sum-at-risk which is based on the requirement at the end of the year. Because the MICR was more sensitive to this issue than the SAM SCR, the MICR would increase at a lower rate relative to the SCR when the microinsurer was growing rapidly which is why the point of inversion is later. In contrast, for a shrinking microinsurer the MICR would grow at a quicker rate resulting in earlier inversion point.

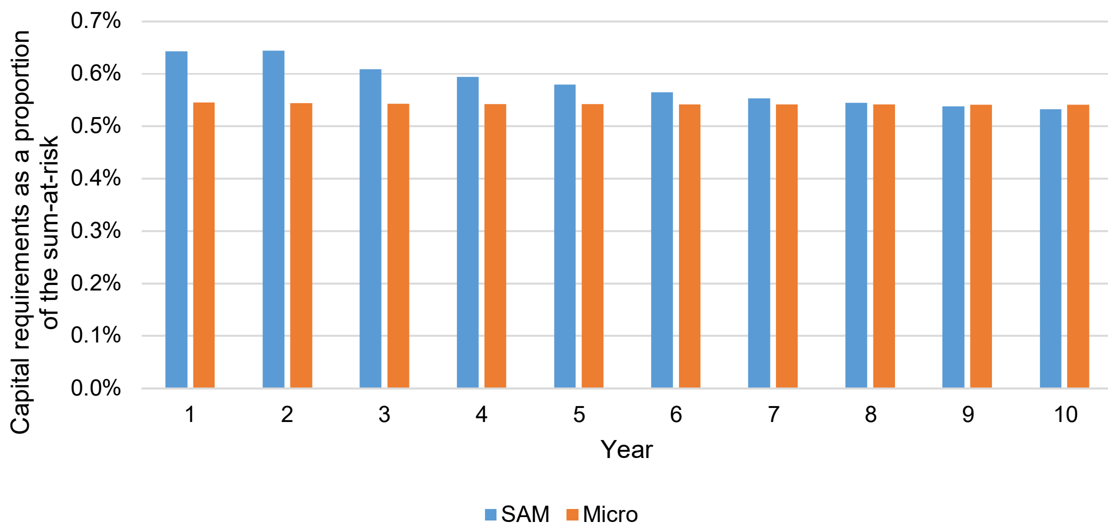

Figure B.3: SAM SCR vs MICR over a ten-year period for a rapidly growing microinsurer

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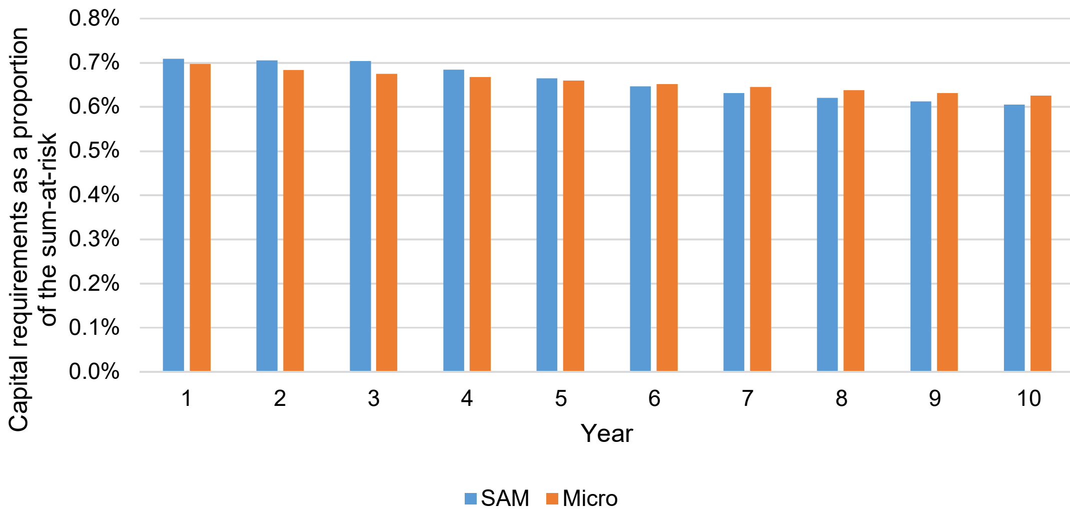

Figure B.4: SAM SCR vs MICR over a ten-year period for a microinsurer closed to new business

B.3. SCENARIO ANALYSIS

For certain results shown in Section 10.3.2, the stresses were calculated assuming the microinsurer held the SCR. The results, assuming the microinsurer holds the MICR are similar and are shown in this section.

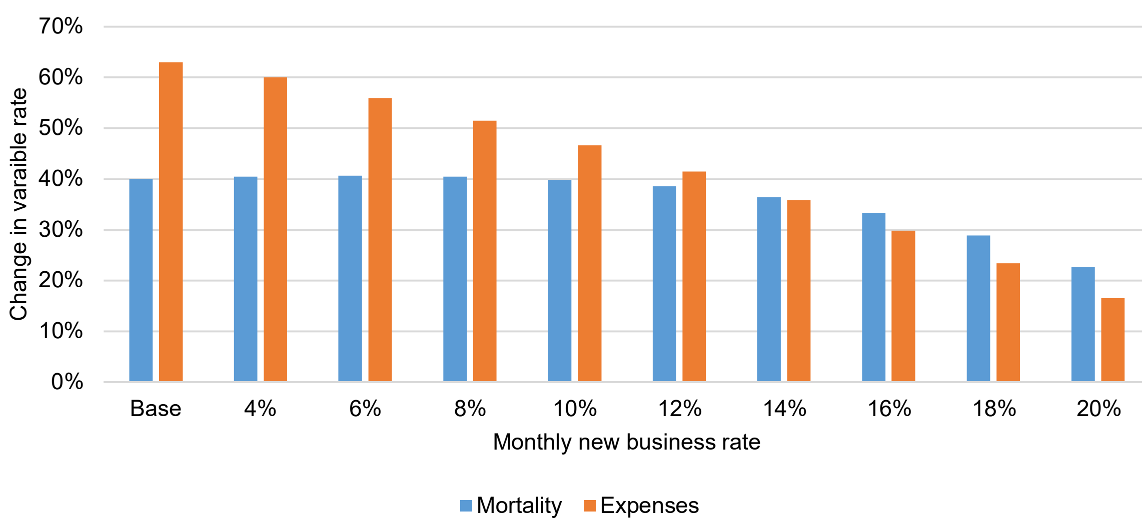

Figure B.5: Comparison of the change in mortality and expenses that results in insolvency for microinsurers with different new business rates

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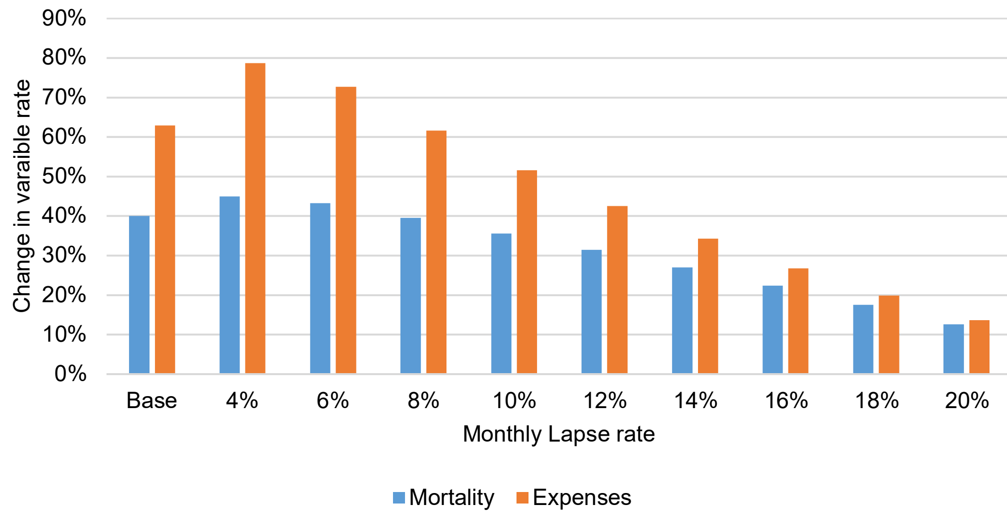

Figure B.6: Comparison of the change in mortality and expenses that results in insolvency for microinsurers different lapse rates

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APPENDIX C:
ADDITIONAL STOCHASTIC ANALYSIS DETAILS

C.1. SIMULATION METHOD

The simulation value for discrete random variables was generated using (C.1) where x_{i-1} is the simulated value, $x_i, i = 1,2,3$ ... are the discrete values that the random variable can take on and $F(\,)$ is the cumulative probability distribution associated with the random variable. The simulation value for continuous random variables was generated using (C.2) where x is the generated value with $x \in A$ where A is the continuous set of values that the random variable can take on and $F(\,)$ is the cumulative probability distribution associated with the random variable. The value, u, is a generated random number between 0 and 1 (Rizzo, 2008: 49–52).

$$F(x_{i-1}) < u < F(x_i) \tag{C.1}$$

$$x = F^{-1}(u) \tag{C.2}$$

C.2. TECHNICAL DETAILS OF DISTRIBUTIONS USED

C.2.1. Mass lapse distribution

The mass lapse distribution was based on a compound distribution shown in (C.3). The cumulative density function of the random variable N_i is shown in (C.4)

$$Z = \sum_{j=1}^{N_i} X_i \tag{C.3}$$

where N_i is the random variable representing the number of mass lapses

$X_{ij} =$ is the random variable representing the severity of the simulated mass lapse i

$$F(x) = \sum_{i=1}^{x} \frac{e^{-\lambda} \times \lambda^i}{i!}, x = 0,1, \dots \tag{C.4}$$